HERST & ASSOCIATES, INC.®

Global Presence
Personal Attention

Mr. Dan Wall
Remedial Project Manager
Superfund Division
USEPA
901 North 5th Street
Kansas City, Kansas 66101

September 16, 2005

Dear Mr. Wall:

West Lake Landfill Operable Unit 2,
Remedial Investigation Report, Baseline Risk Assessment Report,
Responses to EPA Comments

Enclosed are the revised Remedial Investigation Report and revised Baseline Risk Assessment Report for West Lake Landfill Operable Unit 2. The revised Remedial Investigation Report and revised Baseline Risk Assessment Report have been prepared based on EPA comments dated March 11, 2005. A response letter is also enclosed.

As discussed with you during a telephone conversation on September 14, 2005, the above-listed documents are being submitted on September 16, 2005 for EPA receipt on Monday, September 19, 2005. During our telephone conversation, you provided EPA approval for the submittal and delivery dates.

Sincerely,

Herst & Associates, Inc.

Ward Herst

Ward Herst, PG
Managing Director

Cc: Victoria Warren – AWIN
Mike Hockley – Spencer, Fane, Britt & Browne
Rod Bloese – Allied
Jill Bruss - Missouri Department of Natural Resources
Rick Walker – Bridgeton Landfill, LLC.
Paul Rosasco - Engineering Management Support, Inc.

West Lake Landfill
Operable Unit 2
Baseline Risk Assessment

September 16, 2005

Prepared by

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West Lake Landfill
Operable Unit 2
Baseline Risk Assessment

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September 16, 2005

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ACRONYMS

ARARs: Applicable or Relevant and Appropriate Requirements

ATV: All Terrain Vehicles

BRA: Baseline Risk Assessment

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act

CFR: Code of Federal Regulations

cm/sec: centimeters per second

COCs: Contaminants of Concern

COPCs: Contaminants of Potential Concern

FS: Feasibility Study

HEAST: Health Effects Assessment Summary Tables

HQ: Hazard Quotient

ICR: Incremental Cancer Risk

IRIS: Integrated Risk Information System

LCS: Active Sanitary Landfill Leachate Risers

LOAEL: Lowest Observed Adverse Effect Level

LR: Inactive Landfill Leachate Risers

LUST: Leaking Underground Storage Tank

MCLs: Maximum Contaminant Levels

MCLGs: Maximum Contaminant Level Goals

MDNR: Missouri Department of Natural Resources

mg/L: milligram per liter

MW: Monitoring Well

NGVD: National Geodetic Vertical Datum

NOAEL: No Observed Adverse Effect Level

NPDWRs: National Primary Drinking Water Regulations

OU-1: West Lake Landfill Operable Unit 1

OU-2: West Lake Landfill Operable Unit 2

PCB: Polychlorinated Biphenyl

PRGs: Preliminary Remediation Goals

PZ: Piezometer

RAGS: Risk Assessment Guidance for Superfund

RfD: Reference Dose

RI: Remedial Investigation

RME: Reasonable Maximum Exposure

SB: Soil Boring

SCS: Soil Conservation Service

SCSR: Site Characterization Summary Report

SED: Sediment

SF: Slope Factor

SOW: Statement of Work

SW: Surface Water

TOC: Total Organic Carbon

TPH: Total Petroleum Hydrocarbons

USEPA: United States Environmental Protection Agency

USFWS: United States Fish and Wildlife Service

VOCs: Volatile Organic Compounds

1 INTRODUCTION

1.1 Purpose and Scope

This baseline risk assessment (BRA) has been prepared as part of the Remedial Investigation/ Feasibility Study (RI/FS) for West Lake Landfill Operable Unit 2 (OU-2), Bridgeton, Missouri. The BRA provides an assessment of baseline health risks and environmental impacts. It is one of the key elements in the process to evaluate hazardous waste sites as set forth under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

The United States Environmental Protection Agency (USEPA) has recognized that certain categories of sites - for example, municipal landfills - have similar characteristics, such as types of contaminants, types of disposal practices, or how environmental media are affected (USEPA, 1993a). Based on information acquired from evaluating and cleaning up these sites, USEPA has initiated the use of presumptive remedies to accelerate cleanups at these sites. The USEPA has determined that the presumptive remedy guidance for municipal landfills applies to this site (Administrative Order on Consent, Docket No. 111-94-F-0025, Section 22). As part of the presumptive remedy approach, the BRA may be streamlined to facilitate action to address obvious threats to human health or the environment.

The OU-2 BRA has been prepared in accordance with the presumptive remedy approach for municipal landfills. Guidance documents used in preparing this risk assessment include:

- Presumptive Remedies: Policy and Procedures (USEPA, 1993a);
- Superfund Accelerated Cleanup Bulletin: Presumptive Remedies for Municipal Landfill Sites (USEPA, 1993b);
- Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites (USEPA, 1991a);
- Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions (USEPA, 1991b);
- Streamlining the RI/FS for CERCLA Municipal Landfill Sites (USEPA, 1990);
- Risk Assessment Guidance for Superfund, Human Health Evaluation Manual Part A (USEPA, 1989);
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance (USEPA, 1991c);
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessment (USEPA, 1997a); and
- Issuance of Final Guidance: Ecological Risk Assessment and Risk Management Principles for Superfund Sites (USEPA, 1999a).

1.2 Background

The West Lake Landfill is an approximately 200-acre parcel located within the western portion of the St. Louis metropolitan area (Figure 1). It is situated approximately one mile north of the intersection of Interstate 70 and Interstate 270 within the city limits of the City of Bridgeton in northwestern St. Louis County. The Missouri River lies about two miles to the north and west of the site (Figure 1). The site is now almost completely surrounded by commercial/industrial properties.

The site includes an active solid waste landfill, a solid waste transfer station, an inactive demolition landfill, an inactive landfill, concrete and asphalt plants, and an automobile repair shop (Figure 2). The site was used agriculturally until 1939, when a limestone quarry and crushing operation was initiated. The quarry operated until 1988 creating two pits. Landfill operations were initiated in 1979 in the north pit. As of August 1, 2005, the active landfill ceased receiving municipal solid waste pursuant to an agreement with the City of St. Louis to reduce the potential harm to airport operations from birds that may be attracted to a sanitary landfill. This agreement was recorded as a negative easement on the entire site in April 2005.

The West Lake Landfill Site has been divided into two operable units. Operable Unit 1 (OU-1) consists of two areas of radiologically impacted materials present at the West Lake Landfill and a third area of impacted soils at the adjacent off-site property formerly owned by Ford Motor Credit Company and referred to in previous documents as the Ford property. The radiologically impacted materials in OU-1 originated when 8,700 tons of leached barium sulfate residues containing approximately 7 tons of uranium were mixed with approximately 39,000 tons of soil during a cleanup of Cotter Corporation's facilities at 9200 Latty Avenue from July to October, 1973. Cotter Corporation had stored the 8,700 tons of leached barium sulfate residues, which it obtained from the Department of Energy, at the Latty Avenue facility. B&K Construction transported the materials to the site, where it represented the material as "clean" fill to site personnel (NRC 76-01). The materials apparently were used as daily and intermediate cover in routine landfill operations (NUREG - 1308, "Radioactive Material in the West Lake Landfill, Summary Report, " June, 1988). A baseline risk assessment has previously been prepared for OU-1 (Auxier, 1998).

Operable Unit 2 (OU-2) refers to areas where landfill activities have been or are being conducted at the West Lake Landfill, with the exception of Operable Unit 1 Area 1 and Operable Unit 1 Area 2. OU-2 was created because of USEPA's inference that the former limestone quarry area had been used for landfilling municipal refuse, industrial solid and hazardous wastes, and construction demolition debris (USEPA, 1994). USEPA also inferred, based on historic aerial photographs, that standing water pools in what is now the inactive landfill area represented potential liquid disposal areas.

Additional background information on the West Lake Landfill site can be found in the following reports and is incorporated here by reference:

- West Lake Landfill Operable Unit 2 RI/FS Site Characterization Report (Water Management Consultants, 1997);

- Physical Characterization Technical Memorandum for the West Lake Landfill Operable Unit 2, Bridgeton, Missouri (Golder, 1996);

- Site Characterization Summary Report, West Lake Landfill Operable Unit 1 (EMSI, 1997); and

- Baseline Risk Assessment West Lake Landfill Operable Unit 1 (Auxier, 1998).

1.3 Overview of the Risk Assessment Process to Support a Presumptive Remedy

As indicated in USEPA guidance (USEPA, 1991a), options for remedial action at municipal landfill sites are limited. Therefore, it is possible to streamline the scope of the BRA by using a site conceptual model and RI-generated data to perform a qualitative risk assessment that identifies the contaminants of concern in affected media, their concentrations and their hazardous properties that may pose a risk through exposure. Then, contaminant concentrations are compared to standards that are potential chemical-specific applicable or relevant and appropriate requirements (ARARs). When established standards for one or more contaminants in a given medium are clearly exceeded, the basis for taking remedial action is generally warranted and quantitative assessments are not necessary to initiate remedial action. For example, if contaminant concentrations in groundwater exceed maximum contaminant levels (MCLs) or non-zero maximum contaminant level goals (MCLGs), action is generally warranted (USEPA, 1991b).

1.4 Report Organization

The BRA for OU-2 has been prepared using this streamlined approach for evaluating CERCLA municipal landfill sites. Site characterization activities are discussed briefly in Chapter 2. Data collected as part of the site characterization for OU-2 are presented and evaluated in Chapter 3. The site conceptual model and human health risk assessment using potential chemical-specific ARARs to evaluate contaminant concentrations are presented in Chapter 4. A qualitative evaluation of ecological impacts is presented in Chapter 5. Summary and conclusions of the streamlined risk assessment to support the presumptive remedy process is presented in Chapter 6. References used in the BRA for OU-2 are presented in Chapter 7.

2 SUMMARY OF THE SITE CHARACTERIZATION

2.1 Introduction

Field investigative activities for OU-2 were designed to meet the objectives of Section 3.1 of the Statement of Work (SOW). As described in the EPA-approved *Remedial Investigation/ Feasibility Study Work Plan, West Lake Landfill Operable Unit 2, Bridgeton, Missouri (Work Plan), Appendix A-01, Field Sampling Plan* prepared by Golder Associates Inc. (Golder, 1995), the primary objectives of the West Lake Landfill Operable Unit 2 (OU-2) RI were to collect data on and adjacent to OU-2 regarding environmental characteristics, chemical occurrence, potential chemical migration pathways and transport mechanisms.

The tasks that were proposed to meet the objectives of the SOW were summarized in the Work Plan as follows:

Define site physical and biological characteristics:
- surficial geologic investigation,
- ecological evaluation, and
- collection of additional information on site physical characteristics and demographics.

Characterize site hydrogeologic characteristics:
- evaluation of existing well integrity,
- initial hydrogeologic investigation,
- technical memorandum recommending groundwater quality monitoring network, and
- determine groundwater quality.

Define sources of contamination:
- leachate sampling and analysis,
- landfill gas characterization,
- investigation of potential petroleum impacts near well MW-F2, and
- evaluation of potential impacts to groundwater.

Determine surface water and sediment quality:
- surface water sampling and analysis, and
- seep survey, sampling and analysis.

Determine air quality.

Site physical and hydrogeologic characteristics were previously detailed in the *Physical Characterization Technical Memorandum for the West Lake Landfill Operable Unit 2, Bridgeton, Missouri* (Physical Characterization Memorandum) prepared by Golder and dated August 1996. The Site Characterization Summary Report prepared by Water Management Consultants and dated December 1997, discusses the remainder of the RI tasks, which include site biological characteristics, sources of contamination, groundwater quality, surface water and sediment quality and air quality.

2.2 Groundwater

2.2.1 Overview

The *Work Plan* (as cited in the *Site Characterization Summary Report, Volume 1* [Water Management Consultants, 1997]), indicated that a groundwater quality monitoring network would be developed for OU-2 based on a detailed review of the site hydrogeologic conditions, including:

- Horizontal and vertical flow directions,
- Horizontal and vertical hydraulic gradients,
- Aquifer and aquitard permeabilities, and
- Relationship of monitoring points to potential sources of contamination.

A detailed review of the site hydrogeologic conditions was presented in the *Physical Characterization Memorandum*. Four principal hydrogeologic units capable of yielding sufficient water for sampling were identified within and near OU-2. These included, from youngest to oldest, the alluvium, the St. Louis/Upper Salem hydrogeologic unit, the Salem formation and the Keokuk formation. The alluvium is present in the western half of the site. On the eastern portion of the site, the uppermost water is perched within a loess deposit that overlies the St. Louis/Upper Salem hydrogeologic unit, consisting of limestone and dolomite. The St. Louis/Upper Salem hydrogeologic unit grades into the underlying Salem formation, which is also predominantly limestone. The Warsaw formation, a claystone and siltstone aquitard commonly referred to as the Warsaw shale, is present between the Salem formation and the Keokuk formation. The Keokuk formation is classified as predominantly limestone.

The extensive physical characterization of the site allowed development of a detailed hydrogeologic model based on the bulleted items above. Leachate collection has maintained an inward hydraulic gradient from the adjacent Salem, St. Louis/Upper Salem and alluvial hydrogeologic units that was developed when the limestone quarry created a local hydraulic sink by excavating below the water table. The inward hydraulic gradient prevents horizontal migration of leachate away from the landfill into surrounding units. Vertical migration away from the active landfill is prevented by a combination of low-permeability shales that form a natural liner, leachate pumping and an upward hydraulic gradient from the underlying Keokuk formation.

The leachate collection process has maintained a groundwater divide west of the active landfill. East of the divide, groundwater flow is toward the landfill and the leachate collection system. West of the divide, groundwater flow is relatively flat, but generally trends west/northwest toward the Earth City Stormwater Retention Pond.

The OU-2 RI included installation of 49 piezometers that characterize the site hydrogeology and to monitor groundwater elevations in alluvial and bedrock aquifers. These supplemented existing piezometers and monitoring wells across the site. From the newly-installed piezometers and previously existing piezometers/wells, 24 locations were proposed for inclusion in the groundwater quality monitoring network for OU-2. Figure 3 illustrates the OU-2 monitoring locations, plus OU-1 monitoring wells and piezometers.

Piezometers were identified with the prefix "PZ" and suffix designation specific to the formation being monitored. An "A" suffix was used if the piezometer was completed in alluvium (unconsolidated materials). An "S" suffix was used if the piezometer was completed in the Salem or St. Louis Formations. A "K" suffix was used if the piezometer was completed in the Keokuk Formation. The piezometer identifiers were further modified with an additional suffix designating whether the piezometer was completed to the shallow ("S" suffix), intermediate ("I" suffix) or deep ("D" suffix) portion of the aquifer. The following is an example of a piezometer designation.

PZ-100-SS

Where:

PZ=piezometer
100="100" series
The first "S"= completed into the Salem or St. Louis Formations; and,
The second "S"= completed into the upper (shallow) portion of the aquifer.

Because groundwater in the Keokuk formation is hydraulically isolated from the overlying hydrogeologic units, groundwater quality monitoring in the Keokuk formation was not performed. Groundwater quality monitoring from the upper two bedrock hydrogeologic units and the alluvium was performed. Detailed rationale for the selected monitoring locations is presented in the *Physical Characterization Memorandum*.

2.2.2 Background groundwater quality

Bedrock background groundwater quality

Background bedrock groundwater quality data are provided by piezometers PZ-300-SS, PZ-301-SS and PZ-204A-SS. Piezometers PZ-300-SS and PZ-301-SS were installed approximately 2,000 ft. south of OU-2. Piezometer PZ-204A-SS was installed approximately 200 ft. south of OU-2.

The results of bedrock background groundwater quality sampling are contained within Tables 2.1 and 2.2.

Alluvial background groundwater quality

Background alluvial groundwater quality data are provided by wells MW-107, S-80 and I-50, plus piezometer PZ-300-AS. Wells S-80 and I-50, plus piezometer PZ-300-AS, were included in the December 1995 off-schedule sampling event. Tables 2.3 and 2.4 list the reported concentrations on the off-schedule background alluvial groundwater samples.

2.3 Leachate

Leachate sampling and analysis were conducted to determine whether past disposal practices might have resulted in source areas for contamination in the inactive landfill. The leachate sampling points were installed in areas identified by the EPA as potential liquid disposal areas. The data obtained from the leachate risers were intended to be used to identify potential hazardous substances, if present, within these areas of the inactive landfill. In addition to sampling leachate from the inactive landfill, samples of leachate were collected from leachate risers previously installed within the active sanitary landfill. The leachate riser data from the active sanitary landfill can be compared to the leachate quality in the inactive landfill.

Six leachate riser borings were made within the inactive landfill as part of the OU-2 RI. Of these six, one was dry and did not receive a leachate riser, while a second received a leachate riser but consistently exhibited a liquid thickness of less than six inches, which was insufficient for sample collection. The remaining four inactive landfill leachate risers (Figure 3) were sampled to determine leachate quality. Four leachate risers present in the active sanitary landfill were also sampled.

2.4 Surface Water and Sediment Quality

Two surface water and sediment sampling locations were included in the OU-2 RI. The first location was upstream of the site, at a background location south of the site. The second location was within the Earth City Stormwater Retention Pond at a location that would be expected to receive runoff impacts from the inactive landfill, if impacts occurred. The upstream surface water location was designated SW-01 and the upstream sediment location was designated SED-01. The downstream surface water and sediment sampling locations were SW-02 and SED-02, respectively. The downstream surface water and sediment sampling locations were selected to provide data near and potentially downgradient of the monitoring well MW-F2, area which had exhibited potential petroleum impacts through landfill gas monitoring and soil TOC results.

Sediment samples were collected adjacent to the corresponding surface water sampling locations, to allow direct comparison of surface water and sediment quality at the designated locations. Figure 3 illustrates the surface water and sediment sampling locations.

2.5 Soil

Alluvial soil samples from the screened interval in the "300" series piezometers and leachate risers LR-103 and LR-104 were analyzed for total organic carbon (TOC). Soil samples from PZ-303-AS were analyzed for total petroleum hydrocarbons (TPH) and VOCs, due to the piezometers proximity to monitoring well MW-F2. Soil samples collected during drilling of four soil borings near monitoring well MW-F2 were analyzed for TPH and VOCs (for the exact location of the soil boring (SB) samples, please refer to Figure 4).

2.6 Soil Gas

Landfill gas characterization was accomplished using various measuring techniques. Forty-nine borings were completed as part of the OU-2 RI to determine potential landfill gas impacts in the breathing zone. Additional landfill gas monitoring was conducted along the western portion of the inactive landfill. An ATV mounted Geoprobe drill rig advanced expendable sampling points at a depth of approximately 3.5 ft. below ground surface at 10 locations shown in Figure 5.

2.7 Exposure Setting

The following discussion provides a basis for assessing potential impacts to the various environmental resources associated with the West Lake Landfill and identifying exposure pathways for potential human receptors. The exposure setting is characterized by both the natural environment at the site and the local land use and demography. This section includes a description of the West Lake Landfill topographic conditions, surface soil conditions, runoff drainage patterns, surface water bodies in the area and current land uses at and near the West Lake Landfill.

2.7.1 Climate and Meteorology

The St. Louis area has a modified continental climate characterized by moderately cool winters and warm summers. Temperatures measured from 1958 through 1988 ranged from -28°C (-18°F) to 42°C (107°F). Evapotranspiration and precipitation in the area generally balance each other. Annual precipitation typically totals approximately 86 centimeters (34 in.), of which about 25 cm. (10 in.) occurs in the spring. Thunderstorms usually occur between 40 and 50 days per year. Winter is the driest season, with precipitation averaging about 15 cm. (6 in.).

2.7.2 Topography

The West Lake Landfill is situated on the eastern edge of the Missouri River floodplain. The Missouri River is located approximately two miles to the west of the West Lake Landfill. The river flows in a predominantly north-northeasterly direction in the vicinity of the West Lake Landfill at an elevation of approximately 425 feet based on the National Geodetic Vertical Datum (NGVD). The river is separated from the surrounding areas by a levee system constructed to an average of approximately 435 to 440 feet in this area (McLaren/Hart, 1994 [as cited by Auxier, 1998]).

The West Lake Landfill is located in an area that is transitional between the floodplain immediately to the west and the loessial bluffs approximately one-half mile to the east. The edge of the alluvial deposits associated with the river valley is oriented north to south through the center of the West Lake Landfill. The topography of this area is gently rolling, ranging in elevation from approximately 430 to 500 feet (NGVD). West Lake Landfill elevations (exclusive of the quarry areas) range from approximately 450 to 500 feet (NGVD). The West Lake Landfill topography has been significantly altered by: 1) quarry activities in the eastern portion of the West Lake Landfill; 2) placement of mine spoils (unused quarry material); and 3) landfill materials in the western portion of the West Lake Landfill.

2.7.3 Surface Soils

According to the U.S. Soil Conservation Service (SCS), surface soils along the floodplain of the Missouri River generally consist of Blake-Eudora-Waldron association while the surface soils on the bluffs east of the river are the Urban land-Harvester-Fishpot Association (DOA, 1982). The floodplain materials are described as nearly level, somewhat poorly drained to well drained, deep soils formed in alluvial sediment. The upland materials are urban land and nearly level to moderately steep, moderately well drained to somewhat poorly drained, deep soils formed in silty fill material, loess and alluvium which are formed on uplands, terraces and bottom lands.

2.7.4 Subsurface Features

The subsurface conditions beneath the landfill consist of municipal refuse, construction and demolition debris, other wastes and the associated soil cover materials, alluvial deposits and limestone, dolomite and shale bedrock.

2.7.5 Water Supply Wells

The hydrogeology of the West Lake Landfill is dominated by a water table aquifer contained within the alluvial materials beneath the West Lake Landfill (EMSI, 1997). No public water supply wells that obtain water from the alluvial aquifer are present near the landfill [Foth and Van Dyke, 1989 (as cited by Auxier, 1998)]. In addition, there are no residential wells at the West Lake Landfill. Based on a recent survey conducted by Herst and Associates that is incorporated into the OU-2 RI, the nearest well reportedly used as a drinking water source is located about one mile north of the West Lake Landfill. Distances to nearby wells are discussed in the OU-2 RI.

2.7.6 Vegetation and Wildlife

An assessment of the plant communities present at the West Lake Landfill, including the potential for the presence of threatened and endangered species and a description of the types of wildlife observed to be present at the West Lake Landfill was performed by McLaren/Hart (1996) as part of the RI/FS investigations. The results of that survey are presented in the Site Characterization Summary Report (SCSR) (EMSI, 1997).

2.7.6.1 Threatened and Endangered Species

The U.S. Fish and Wildlife Service has stated that "No federally-listed endangered or threatened species occur in this project area" (USFWS, 1994).

2.7.6.2 Wildlife

Numerous species and signs of species of wildlife were observed to be present in the West Lake Landfill area during the activities associated with the biological survey. Species noted included deer, rabbits, red-winged blackbirds, robins and crows.

A great blue heron was observed flying above the West Lake Landfill and landing in the south flood control channel (McLaren/Hart, 1996). This species is likely to use aquatic habitats both on and off-site, but it will feed only in those waters containing prey species of fish or amphibians.

In addition, fecal pellets and an observed den may be due to coyotes, red fox, or possibly both. The home range of these species is large enough to include the entire West Lake Landfill and the presence of rabbits suggests a food source for these species (McLaren/Hart, 1996).

2.7.7 Land Use

2.7.7.1 Current Land Use

The West Lake Landfill is located in a predominantly industrial area. The southern portion of the West Lake Landfill is zoned M-1 (manufacturing district, limited). The southernmost portion of the West Lake Landfill is permitted for active sanitary landfill operations (Permit No. 118912). Although the northern portion of the West Lake Landfill is zoned R-1 (one family dwelling district), this area has never been used for residential purposes, is bounded on all sides by industrial and commercial uses, and has been used for industrial purposes for more than fifty years. Moreover, the Missouri Court of Appeals affirmed a trial court's finding that the "residential" zoning of the West Lake Quarry property directly south of the West Lake Landfill was unconstitutional, unreasonable, and arbitrary. West Lake Quarry and Material Company v.

City of Bridgeton, 761 S.W. 2d 749 (Mo. App. 1988). The court specifically considered the commercial-industrial land uses of the surrounding property, the high development costs for residential, noise from airplanes, and other evidence and concluded that property in this area is "totally inappropriate for residential development" and ordered the City to rezone the property M-2 (commercial-industrial) [Id. at 752]. Even though a portion of the Site is zoned residential, as a practical matter, the only reasonable future use of the Site is commercial-industrial, not residential. In addition, deed restrictions have been recorded against the entire West Lake Landfill. Residential land use and groundwater use have been prohibited at the West Lake Landfill by restrictive covenants recorded by each of the property owners against their respective parcels. The covenant restrictions cannot be terminated without the written approval of the future owners, Missouri Department of Natural Resources (MDNR) and USEPA.

2.7.7.2 Future Land Use

In determining the reasonably expected future use for a site and whether to include a residential scenario in the risk assessment, EPA guidance suggests that "scenarios for … [residential] land use should be evaluated whenever there are homes on or near the Site, or when residential development is reasonably expected in the future. In determining the potential for further residential land use, the … [risk assessment] should consider historical land use; suitability for residential development; local zoning; and land use trends" (USEPA, 1991c). Of the four factors to consider, only the current residential zoning for a portion of the Site points toward a future residential use, and the court's decision in West Lake Quarry and Material v. City of Bridgeton, supra, has determined such use is inappropriate for the area. The other three factors weigh against a future residential use.

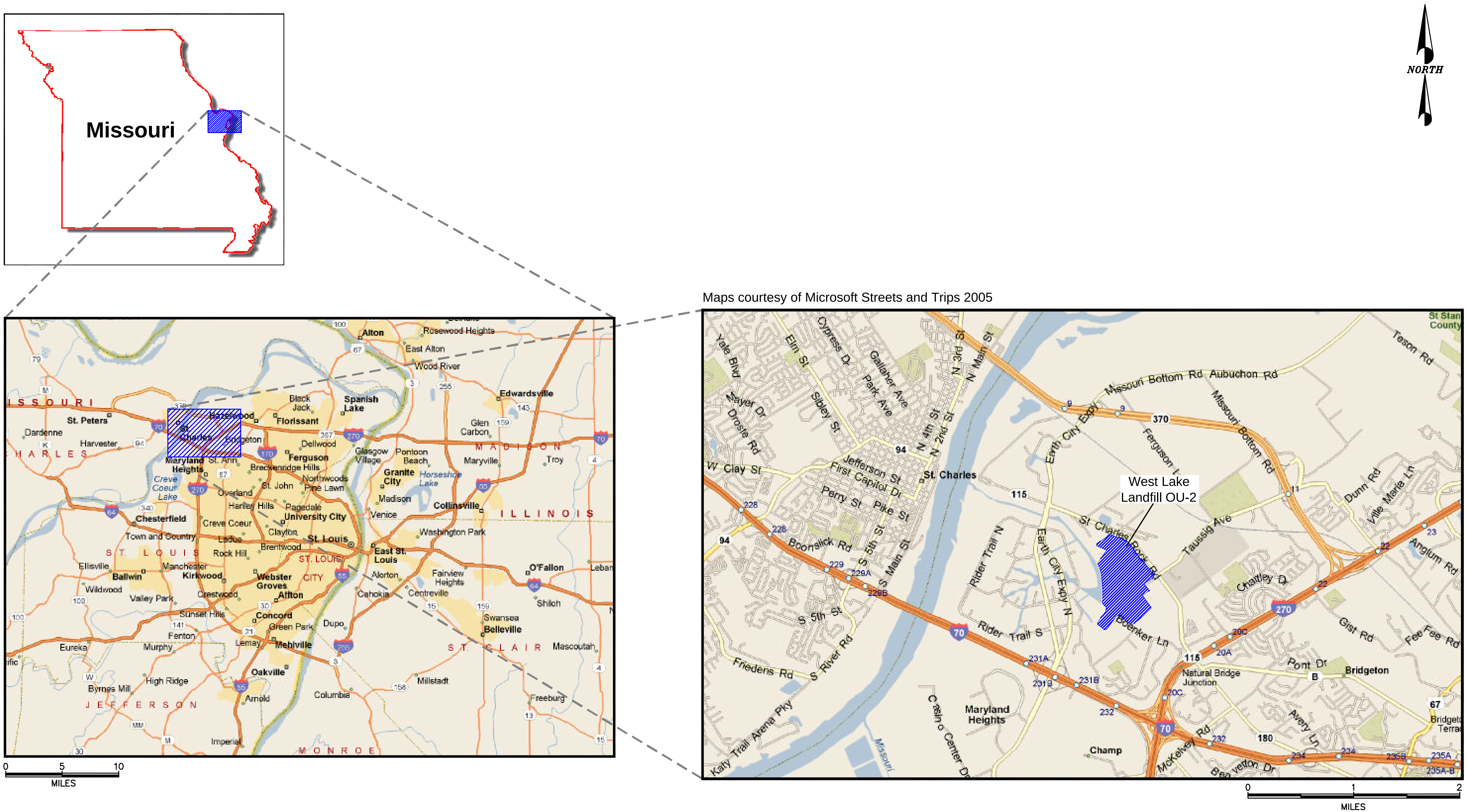
Based on the current and past use of the Site, the expanding industrial and commercial uses of the properties surrounding the Site, and the unsuitability of the Site for residential use, this risk assessment assumes that the reasonable expected future use of the Site will be industrial or commercial and that there will be no future residential use. This risk assessment also assumes that the current restrictive covenants remain in effect because they cannot be terminated without the written approval of the current or future owners, MDNR and USEPA.

2.7.8 Demography

The property to the north of the West Lake Landfill, across St. Charles Rock Road, is moderately developed with commercial, retail and manufacturing operations. The Earth City industrial park is located adjacent to the West Lake Landfill on the west, across the Old St. Charles Rock Road. The nearest residential development, "Spanish Village", is located south of the West Lake Landfill near the intersection of St. Charles Rock Road and I-270. Mixed commercial, retail, manufacturing and single family residential uses are present to the southeast of the West Lake Landfill.

2.7.9 Critical Subpopulations

According to USEPA Guidance (USEPA, 1989), a baseline risk assessment must identify subpopulations of potential concern, if they exist, that could be at increased risk from radionuclide or chemical exposure from increased sensitivity, behavior patterns and current or past exposures from other sources. No critical subpopulations have been reported or identified for the immediate vicinity to the site.



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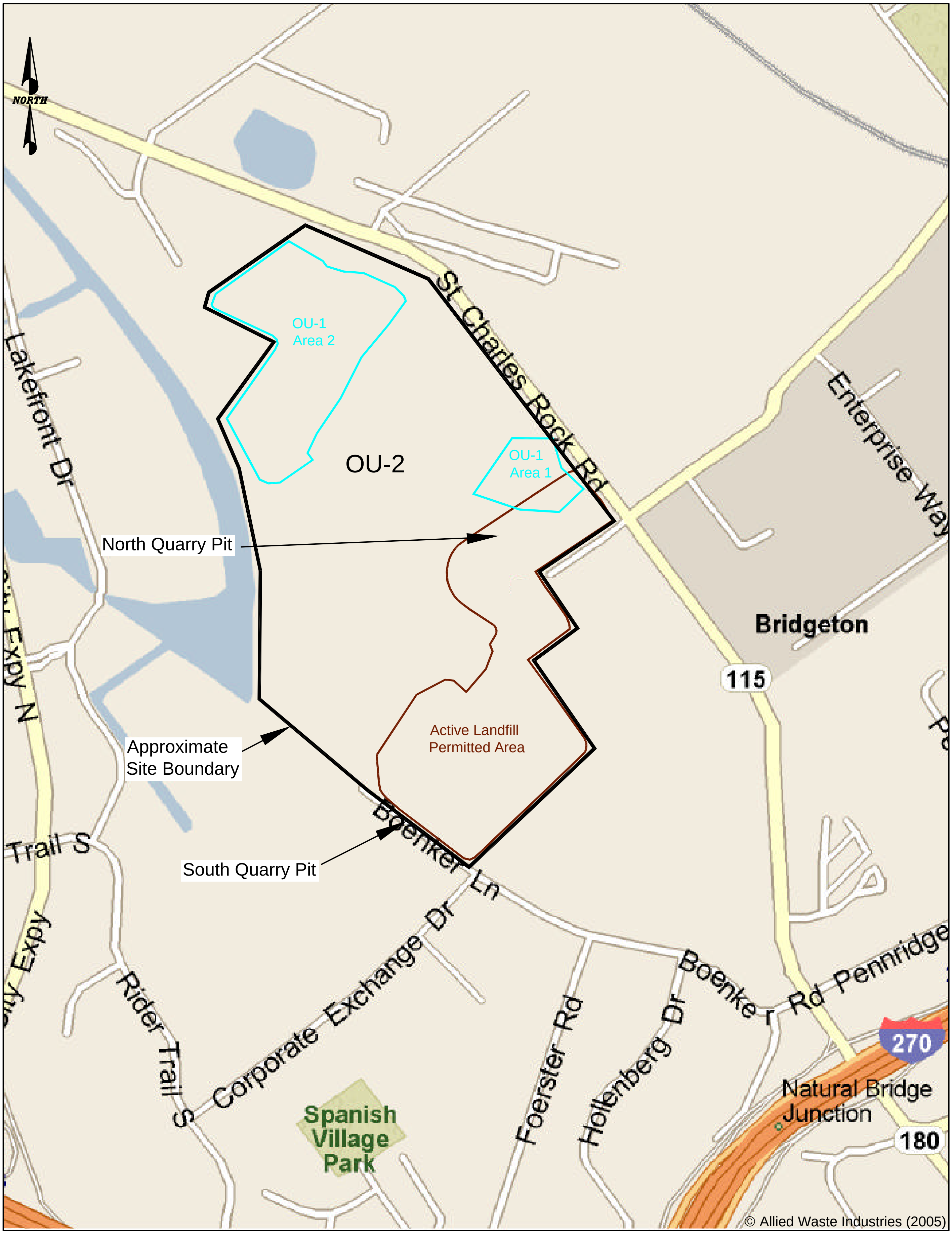
West Lake Landfill OU-2
Bridgeton, Missouri

Figure 1
Site Vicinity Map



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West Lake Landfill OU-2
Bridgeton, Missouri

Figure 2
Site Location Map

Table 2.1 Background Bedrock Groundwater Quality Results
(Metal and Conventional Parameters)
December 1995 Sampling Event

Parameter	GW-300-SS (mg/L)
Calcium	73.9
Potassium	<5
Magnesium	56.4
Sodium	10.7
Chloride	6
Sulfate	20
Bicarbonate as alkalinity	500
Nitrate/Nitrite	<0.1
Chemical oxygen demand	50

Table 2.2 Background Bedrock Groundwater Radionuclide Results (pCi/L)

Parameter	GW-300-SS (unfiltered)	GW-300-SS (filtered)
Gross Alpha	3.51+/-2.69	<3.32
Gross Beta	4.37+/-2.25	<3.72
Radium-226	0.78+/-0.09	0.60+/-0.08
Radium-228	0.39+/-0.37	<0.43
Uranium-238	0.25+/-0.13	0.50+/-0.20
Uranium-235/236	0.32+/-0.17	0.13+/-0.11
Uranium-234	0.80+/-0.26	0.89+/-0.28
Thorium-232	<0.092	<0.11
Thorium-230	0.84+/-0.29	0.29+/-0.17
Thorium-228	<0.13	<0.15

Table 2.3 Background Alluvial Groundwater Quality Results
(Metals and Conventional Parameters)
December 1995 Sampling Event

Parameter	GW-300-AS (mg/L)	GW-300-AD (mg/L)	GW-S-80 (mg/L)	GW-I-50 (mg/L)	GW-MW-107 (mg/L)
Calcium	142	176	151	159	131
Potassium	<5	6.1	5.4	<5	<5
Magnesium	41.6	61.1	51.5	57.9	52.6
Sodium	73.0	38.6	66.1	35.4	35.8
Chloride	210	150	250	160	130
Sulfate	110	100	67	26	70
Bicarbonate As alkalinity	280	460	330	460	400
Nitrate/ Nitrite	<0.1	<0.1	<0.1	<0.1	<0.1
Chemical Oxygen Demand	<20	<20	<20	<20	<20

Table 2.4 Background Alluvial Groundwater Radionuclide Results

Well/ Piezometer	Gross Alpha	Gross Beta	Ra-226	Ra-228	U-238	U-235/236	U-234	Th-232	Th-230	Th-228
GW-300-AS (unfiltered)	<3.53	9.34±1.64	0.31±0.05	<0.55	0.57±0.20	<0.17	0.74±0.23	0.22±0.14	0.51±0.21	<0.14
GW-300-AS (filtered)	<4.18	4.08±2.28	0.20±0.003	<0.32	0.55±0.18	<0.13	0.58±0.19	<0.21	0.26±0.18	<0.20
GW-300-AD (unfiltered)	5.49±3.51	8.47±2.43	0.51±0.07	1.00±0.54	0.26±0.13	<0.13	0.32±0.15	0.13±0.11	0.83±0.30	0.18±0.13
GW-300-AD (filtered)	<4.05	<4.07	0.35±0.05	<0.41	0.17±0.09	<0.10	0.40±0.15	0.12±0.08	0.50±0.19	<0.10
GW-S-80 (unfiltered)	56.1±9.5	53.1±6.2	0.44±0.06	<0.65	1.19±0.35	0.27±0.17	0.99±0.31	0.86±0.28	1.48±0.40	0.85±0.28
GW-S-80 (filtered)	<7.02	<3.94	0.19±0.04	<0.42	0.63±0.21	0.16±0.11	0.88±0.26	<0.11	0.31±0.16	<0.13
GW-1-50 (unfiltered)	<4.32	5.12±2.52	0.42±0.06	<0.40	0.15±0.10	0.18±0.12	0.43±0.18	0.17±0.12	1.00±0.33	<0.12
GW-1-50 (filtered)	<4.06	6.02±3.00	0.29±0.04	<0.48	<0.097	<0.14	0.25±0.13	0.21±0.13	0.93±0.30	<0.11
GW-MW-107 (unfiltered)	<4.64	4.38±2.49	<0.066	<0.68	0.26±0.13	<0.09	0.43±0.17	0.33±0.17	0.29±0.16	<0.26±0.15
GW-MW-107 (filtered)	<3.03	<3.96	0.069±0.029	<0.39	0.36±0.16	<0.10	0.39±0.17	<0.085	0.27±0.15	<0.11

Notes:
All results are in pCi/L
Samples collected December 1995

3 DATA EVALUATION

3.1 Groundwater sampling and analysis procedures

Two groundwater quality sampling rounds were conducted as part of the West Lake Landfill OU-2 RI. The first sampling round began in February 1997 and extended into March 1997. The second sampling round began May 1997 and extended into June 1997. An additional, off-schedule groundwater sampling event occurred in December 1995. For more details as to sample collection methodology and quality control, please see the *Site Characterization Summary Report, Volume 1* (Water Management Consultants, 1997). A list of groundwater samples collected in the February and May 1997 sampling events were analyzed for the constituents listed in Table 3.1. Supplemental groundwater sampling was conducted in December 2003 and May 2004 from selected groundwater monitoring wells, pursuant to EPA recommendations and approval. The supplemental groundwater sampling events were conducted to verify that the groundwater quality remained consistent with the 1997 remedial investigation results that formed the basis of the baseline risk assessment. As detailed in monthly progress reports dated March 9, 2004 and August 9, 2004, the December 2993 and May 2004 results were similar to the results collected in 1997.

3.1.1 Groundwater Sampling Results

Detection monitoring results are considered to be all groundwater samples that were not collected from background monitoring locations described in Section 4.4 of the OU-2 Site Characterization Summary Report (Water Management Consultants, 1997). Detection monitoring results are representative of groundwater sampling results from piezometers and wells installed adjacent to the OU-2 boundary. Many of the sampling points are upgradient of the site due to the inward hydraulic gradient established by the active sanitary landfill leachate collection system. Others are internal to the site and are hydraulically downgradient of selected on-site facilities yet upgradient of the active solid waste landfill. Others, particularly the alluvial piezometers and wells west of the inactive landfill, are hydraulically downgradient of the site.

Bedrock background groundwater quality

Background bedrock groundwater quality data are provided by piezometers PZ-300-SS, PZ-301-SS, and PZ-204A-SS. Briefly, no volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were detected in the background bedrock piezometers sampled during the two scheduled sampling rounds. Selected metals were detected, as were selected radionuclides. The detected metals and radionuclides are presented in Table 3.2.

Alluvial background groundwater quality

Background alluvial groundwater quality data are provided by wells MW-107, S-80 and I-50, plus piezometer PZ-300-AS. No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were detected in MW-107 in either of the two sampling rounds. Wells S-80 and I-50, plus piezometer PZ-300-AS, were included in the December 1995 off-schedule sampling event, however sampling did not include organic data during the off-schedule December 1995 event. Selected metals and inorganic compounds were detected as shown in Table 3.3.

St. Louis/Upper Salem Hydrogeologic unit

Thirteen piezometers were used to collect groundwater samples from the St. Louis/Upper Salem hydrogeologic unit near OU-2. These are listed below:

PZ-100-SS	PZ-204A-SS
PZ-102R-SS	PZ-206-SS
PZ-1201-SS	PZ-113-SS
PZ-104-SS	PZ-208-SS
PZ-106-SS	PZ-300-SS
PZ-110-SS	PZ-301-SS
PZ-201A-SS	

Volatile organic compounds were detected only sporadically in St. Louis/Upper Salem piezometers and were detected at low concentrations. The detected VOCs were limited to acetone, benzene, 1,2-cis-dichloroethene and total xylenes. Only five piezometers exhibited one or more detectable VOCs. These included PZ-100-SS, PZ-110-SS, PZ-1201-SS, PZ-106-SS and PZ-301-SS. None of the VOCs was detected in both sampling rounds. Furthermore, no single piezometer exhibited detectable concentrations of VOCs in both sampling rounds. All of the detections were at or near the reporting limit.

Acetone was detected in only one St. Louis/Upper Salem piezometer and in only one of the two rounds. Acetone was detected at the laboratory sampling limit of 0.005 mg/L in PZ-1201-SS during the February sampling round, but was not detected in any St. Louis/Upper Salem piezometer during the second sampling round.

Benzene was detected at a concentration of 0.011 mg/L in PZ-1201-SS in the first sampling round compared to a reporting limit of 0.002 mg/L, but was not detected in the second sampling round. Benzene was also detected in PZ-102R-SS and PZ-106-SS during the second sampling round at low concentrations of 0.0028 mg/L and 0.0031 mg/L, respectively, but was not detected in these piezometers during the first round.

Only two additional samples exhibited an organic result above reporting limits. Cis-1,2-dichloroethene was reported at 0.0024 mg/L in PZ-110-SS during round two, but was not detected during the first sampling round. Total xylenes were detected at 0.003 mg/L, 0.002 mg/L and 0.002 mg/L in piezometers PZ-102R-SS, PZ-104-SS and PZ-201A-SS, respectively, during the second sampling round, compared to a detection limit of 0.002 mg/L. Total xylenes were not detected in the first sampling round.

No semi-volatile organic compounds were detected in the St. Louis/Upper Salem piezometers in either sampling round.

One pesticide was detected in one piezometer in only one of two sampling rounds. Gamma-chlordane was detected at a concentration of 0.000051 mg/L in the first sampling round compared to a detection limit of 0.00005 mg/L. Gamma-chlordane was not detected in the second sampling round.

No PCBs were detected in either sampling round.

Table 3.4 compares the range of metal concentrations, conventional concentrations, radionuclide activities and volatile/semi-volatile organic concentrations in the St. Louis/Upper Salem piezometers to the background range for detected samples only. Many of the metals and conventionals were undetected in both the background and detection piezometers. These include beryllium, cadmium, total chromium, cobalt, copper, lead, mercury, silver, thallium, vanadium and total cyanide.

Six piezometers account for all the maximum metal and conventional concentrations in the detection wells. These include PZ-1201-SS, PZ-102R-SS, PZ-110-SS, PZ-100-SS, PZ-113-SS and PZ-201A-SS. Piezometers PZ-102R-SS, PZ-100-SS and PZ-201A-SS are located on the perimeter of the OU-2 area, in locations that have been shown to be consistently upgradient of OU-2. Maximum metal and conventional concentrations in these locations therefore represent natural variability common to metal and conventional parameters. Piezometer PZ-1201-SS is located immediately adjacent to the northeast corner of the active landfill area. PZ-1201-SS exhibited maximum concentrations of dissolved antimony, nitrate/nitrite and total phosphorus. Maximum detection values should be compared to background values to determine potential groundwater quality differences. As shown in Table 3.4, the maximum concentrations of the parameters in PZ-1201-SS are approximately equivalent to background concentrations. Therefore, the parameters that exhibited their maximum concentrations in the PZ-1201-SS represent background, unimpacted water quality.

Piezometers PZ-110-SS and PZ-113-SS are located in the areas internal to the site. Twenty-four of the 36 maximum metal and conventional concentrations were detected in either PZ-110-SS or PZ-113-SS. Given the presence of the active landfill, demolition landfill, OU-1 Area 1, OU-1 Area 2, previously filled active landfill area, asphalt plant and concrete plant near PZ-110-SS and PZ-113-SS, the presence of metals and conventional compounds in these two piezometers is reasonable.

Deep Salem Hydrogeologic Unit

Five piezometers/wells were used to monitor groundwater quality in the Deep Salem hydrogeologic unit. These include PZ-100-SD, PZ-104-SD, PZ-106-SD and MW-1204.

Only one VOC was detected above the reporting limit in either of the sampling rounds and was detected in only one piezometer. Benzene was detected at a concentration of 0.013 mg/L in PZ-111-SD during the second sampling round, but was not detected in the first sampling round.

No semi-volatile organics, pesticides or PCBs were detected in the Salem groundwater samples. Table 3.5 compares the range of metal concentrations, conventional concentrations, radionuclide activities and volatile/semi-volatile organic concentrations in the Deep Salem piezometers to the background range for the St. Louis/Upper Salem hydrogeologic unit for detected samples only. No Deep Salem background piezometers were installed as part of the OU-2 RI. Differing depositional history can often result in different metal, conventional and radionuclide concentrations between two geologic units. Conclusions drawn based on Table 3.5 should take into account the fact that the results are based on two different geologic horizons.

Many of the metals and conventionals were undetected in the Deep Salem detection piezometers. These include antimony, beryllium, boron, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium and total cyanide. The range of concentration for all metal and conventional parameters in the Deep Salem groundwater samples is similar to the background range, with the possible exceptions of barium and manganese. Similar to the results for the St. Louis/Upper Salem groundwater samples, the range of barium and manganese concentrations for the detection samples is higher than the background range. However, the range for the St. Louis/Upper Salem and Deep Salem groundwater samples are similar to each other, suggesting that the results for both the St. Louis/Upper Salem and Deep Salem hydrogeologic units represent natural variability.

The Deep Salem groundwater results do not suggest impacts from on-site activities.

Alluvium

Eleven alluvial groundwater monitoring locations were incorporated into the OU-2 RI. These include:

PZ-303-AS	MW-107
PZ-304-AS	PZ-300-AS
PZ-304-AI	PZ-300-AD
PZ-113-AS	S-80
PZ-113-AD	I-50
MW-103	

Piezometers/wells PZ-300-AS, PZ-300-AD, S-80, I-50 and MW-107 were included in the off-schedule sampling event conducted in December 1995. These locations provide background alluvial groundwater quality data. Piezometers/wells PZ-300-AS, PZ-300-AD, S-80 and I-50 were decommissioned prior to the two scheduled RI sampling rounds.

Only five of the alluvial monitoring locations exhibited detectable concentrations of VOCs above the reporting limit. These include PZ-113-AS, PZ-113-AD, MW-103, PZ-303-AS, PZ-304-AS and PZ-304-AI. Piezometers PZ-303-AS, PZ-304-AS and PZ-304-AI were installed near monitoring well MW-F2, in an area of suspected petroleum impacts. Monitoring well MW-103 is located along the western side of the inactive landfill. PZ-103-AS and PZ-113-AD are located between the inactive landfill, the demolition landfill, OU-1 Area 2, OU-1 Area 1 and the previously-filled active landfill permitted area.

VOCs in PZ-113-AS and PZ-113-AD were limited to chlorobenzene in PZ-113-AS and 1,1-dichloroethane in PZ-113-AD. Chlorobenzene was detected in PZ-113-AS at a concentration of 0.0086 mg/L in the first sampling round and 0.003 mg/L in the second sampling round, compared to a reporting limit of 0.002 mg/L. 1,1-dichloroethane was detected at the reporting limit of 0.002 mg/L in PZ-113-AD during the second sampling round, but was not detected in the first sampling round.

A greater number of VOCs were detected in PZ-303-AS, PZ-304-AS, PZ-304-AI and MW-103 than in the other alluvial wells. Table 3.6 summarizes the VOC concentrations in these sampling locations.

One alluvial piezometer yielded detectable concentrations of semi-volatile organic compounds. PZ-303-AS exhibited detectable concentrations of four semi-volatile organic compounds in the first sampling round and three semi-volatile organic compounds in the second sampling round.

The semi-volatile organic compounds dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene were detected in MW-107 at concentrations of 0.0002 mg/L and 0.00015 mg/L, respectively. No pesticides or PCBs were detected in the alluvial wells during sampling conducted by the primary lab. However, sampling conducted by the split lab did detect two PCBs (Arochlor-1248 and

1260), one of which was detected in repeat sampling (Arochlor-1248). These results are discussed in more detail in Section 3.1.3.

Table 3.7 compares the range of metal concentrations, conventional concentrations, radionuclide concentrations and volatile/semi-volatile organic concentrations in the alluvial piezometers to the background range in detected samples only. Many of the metals and conventionals were undetected in both the background and detection samples. These include antimony, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, silver, thallium, vanadium, dissolved zinc and total cyanide.

Five metals and conventional parameters (arsenic, barium, boron, iron and ammonia as N) exhibit a maximum detection sample result that is 10 times or more greater than the background maximum concentration. The maximum concentration for each of these parameters was exhibited by piezometers PZ-303-AS or PZ-304-AS, which are located along the western side of the inactive landfill.

No source of radioactivity in OU-2 has been identified or suspected. Based on the radiological data collected as part of the OU-2 RI, groundwater quality appears to reflect natural radioactivity.

3.1.2 Petroleum Impacts Near MW-F2

One of the goals of the OU-2 RI was to investigate potential petroleum impacts near monitoring well MW-F2 and west/southwest of the asphalt plant leaking underground storage tank site (LUST site) within the boundaries of OU-2.

Purgeable-range (i.e., light-range) petroleum hydrocarbons and extractable-range (i.e., heavy-range) petroleum hydrocarbons were analyzed in groundwater samples. The results for PZ-303-AS, PZ-304-AS and PZ-304-AI are summarized briefly as follows:

Sample location	Purgeable-range hydrocarbons (mg/L)		Extractable-range hydrocarbons (mg/L)	
	Feb 97	May 97	Feb 97	May 97
PZ-303-AS	1.3	3.12	19	10
PZ-304-AS	<0.05	0.08	0.99	0.6
PZ-304-AI	<0.05	0.53	0.61	0.4

As shown, there are detectable petroleum hydrocarbons in the alluvial groundwater samples collected from these locations. The highest concentrations were present in samples collected from PZ-303-AS, installed closest to MW-F2 (approximately 75 ft.). The maximum concentration of total petroleum hydrocarbons is 20.3 mg/L (the total hydrocarbons in PZ-303-AS in February 1997).

3.1.3 Resampling of PZ-303-AS

To provide the best possible suite of data from which to characterize OU-2 site conditions, a third groundwater sample was collected from PZ-303-AS. This additional sample was collected March 1997 and was analyzed for pesticides/PCBs. The additional sampling was undertaken because of discrepancies in PCB results for PZ-303-AS between the primary laboratory and split laboratory based on the February 1997 samples. The split laboratory detected two PCBs in the February 1997 sample collected from PZ-303-AS. The split laboratory detected Arochlor-1248 and

Arochlor-1260 in the February 1997 sample, at concentrations of 0.025 mg/L and 0.0087 mg/L, respectively. The primary laboratory did not detect any PCBs in the February 1997 PZ-303-AS sampling event at a detection limit of 0.0005 mg/L. The March 1997 resample included both filtered (dissolved) and unfiltered (total) pesticide/PCB analyses. The split laboratory did not detect any pesticides/PCBs in the filtered (dissolved) resample, but detected Arochlor-1248 at a concentration of 0.0012 mg/L in the unfiltered (total) sample. Consistent with the February 1997 sample, the primary laboratory did not detect any pesticides or PCBs in the resamples, either as filtered or unfiltered. The primary laboratory maintained a PCB reporting limit of 0.0005 mg/L for the resamples, which is lower than the reported Arochlor-1248 concentration from the split laboratory.

3.2 Landfill Gas Characterization

Landfill gas characterization was accomplished using various measuring techniques. 49 borings were completed as part of the OU-2 RI to determine potential landfill gas impacts in the breathing zone. Additional landfill gas monitoring was conducted along the western portion of the inactive landfill. An ATV mounted Geoprobe drill rig advanced expendable sampling points at a depth of approximately 3.5 ft. below ground surface at 10 locations shown in Figure 5. The holes were observed for natural venting. If natural venting of landfill gas was observed, the holes were allowed to vent for approximately 20 minutes before sampling. If natural venting was not observed, a peristaltic pump was attached and the hole was purged for 20 minutes to draw landfill gas to the hole. Results of the soil gas are presented in Table 3.8. Hydrogen sulfide was not detected in any of the 10 locations. The percent lower explosive limit was zero in eight of the ten locations. SG-03 exhibited a landfill gas concentration at 3% of the lower explosive limit at a depth of 3.5 ft. below ground surface. Location SG-08, near monitoring well MW-F2, exhibited a landfill gas concentration of 130% of the lower explosive limit at a depth of 3.5 ft. below ground surface. Locations SG-03 and SG-05 were the only two to exhibit detectable concentrations of organic vapors. These landfill gas results indicate sporadic, isolated landfill gas impacts near the inactive landfill and are typical for a solid waste landfill.

Direct measurements of landfill gas were made by collecting gas in SUMMA canisters from 10 boreholes drilled within the inactive landfill. The boreholes were installed along the crest of the inactive landfill in areas where landfill gas would likely accumulate. SUMMA canisters were used to directly collect samples of landfill gas for subsequent laboratory analysis or organic compounds using EPA method TO-14.

An additional landfill gas sample was collected from the headspace in monitoring well PZ-1201-SS. The headspace sample was collected to determine if landfill gas is impacting groundwater quality adjacent to the landfill areas. The headspace sample yielded detectable concentrations of chloromethane, methylene chloride, benzene, ethyl benzene, xylene, acetone, carbon disulfide and methyl ethyl ketone. Groundwater in piezometer PZ-1201-SS exhibited detectable concentrations of acetone and benzene. These results confirm that landfill gas at the site has the potential to impact groundwater and can be considered a potential source of low-levels of organic compounds in groundwater.

Table 3.9 gives more results pertaining to landfill gas monitoring.

3.3 Leachate Sampling and Analysis

Leachate sampling and analysis were conducted to determine whether past disposal practices might have resulted in source areas for contamination in the inactive landfill. The leachate sampling points were installed in areas identified by the USEPA as potential liquid disposal areas. The data obtained from the leachate risers were intended to be used to identify potential hazardous substances, if present, within these areas of the inactive landfill. In addition to sampling leachate from the inactive landfill, samples of leachate were collected from leachate risers previously installed within the active sanitary landfill. The leachate riser data from the active sanitary landfill can be compared to the leachate quality in the inactive landfill.

Six leachate riser borings were made within the inactive landfill as part of the OU-2 RI. Of these six, one was dry and did not receive a leachate riser, while a second received a leachate riser but consistently exhibited a liquid thickness of less than six inches, which was insufficient for sample collection. The remaining four inactive landfill leachate risers were sampled to determine leachate quality. Four leachate risers present in the active sanitary landfill were also sampled.

Table 3.10 compares organic compounds above the laboratory reporting limit for the leachate risers in the active sanitary landfill (labeled with the prefix "LCS") to organic compounds above laboratory reporting limit for the leachate risers in the inactive landfill (labeled with the prefix "LR"). Organic compound detection frequency was low in each group of leachate risers. Only one organic compound (total petroleum hydrocarbons) was detected in two of the four inactive landfill leachate samples (LR-103 and LR-104). All other organic compounds were below detection in these two samples.

Radionuclide concentrations in the inactive landfill leachate samples were similar to the radionuclide concentrations in the active sanitary landfill leachate (See Appendix C in the *Site Characterization Summary Report, Volume 1* [Water Management Consultants, 1997]). The active sanitary landfill is not permitted to accept radioactive waste. Based on the similar radionuclide concentrations, a significant source of radioactivity is not present in the inactive landfill.

3.4 Surface Water and Sediment Quality

3.4.1 Analytical Results

Surface Water

Appendix C in the *Site Characterization Summary Report, Volume 1* (Water Management Consultants, 1997) presents surface water quality results for the primary and split laboratories. Surface water samples were analyzed for the same compounds as groundwater. As shown in Appendix C, all volatile organic, semi-volatile organic, pesticide and PCB results were below detection in both the upstream sample and in the sample collected west of the inactive landfill. With regard to inorganic parameters, the upstream and downstream surface waters exhibit similar concentrations. The radiological results are also consistent between the upstream and downstream sampling.

In summary, based on the surface water results, the OU-2 area is not contributing measurable contamination for the Earth City Stormwater Retention Pond.

Sediment

Sediment samples were analyzed for the same list of compounds as groundwater and surface water, except that all metals were analyzed as total, conventionals included only total cyanide and sulfide and radionuclides were not analyzed. Consistent with the USEPA-approved Work Plan, the sediment analyte list included VOCs, semi-volatile organics, pesticides, PCBs, petroleum hydrocarbons, total cyanide, sulfide and metals.

Based on the data presented in Appendix C, the upstream sediment quality is consistent with the downstream sediment quality, with similar parameters detected at similar concentrations. With the exception of acetone and methyl ethyl ketone in the upstream sediment sample, all volatile organic, semi-volatile organic, pesticide and PCB results were below detection. Inorganic concentrations in the upstream and downstream sediment samples were similar.

Based on the sediment results, the OU-2 area is not contributing measurable contamination to the Earth City Stormwater Retention Pond.

3.5 Soil Quality

Alluvial soil samples from the screened interval in the "300" series piezometers and leachate risers LR-103 and LR-104 were analyzed for total organic carbon (TOC). Soil samples from PZ-303-AS were analyzed for total petroleum hydrocarbons (TPH) and VOCs, due to the piezometers proximity to monitoring well MW-F2. Soil samples collected during drilling of four soil borings near monitoring well MW-F2 were analyzed for TPH and VOCs Figure 4 contains the exact locations of the soil boring samples.

Based on the soil gas borehole TOC results, TOC values near the ground surface west of the inactive landfill range from about 2,300 mg/kg (0.23%) to 10,000 mg/kg (1%). These results may be biased high because of potential landfill gas migration through the near surface soils adjacent to the inactive landfill, which would have allowed transfer of organic compounds from the gas phase to the soils. Based on the piezometer and leachate soil TOC results, background TOC in the alluvium at depth is approximately 240 to 480 mg/kg (0.024% to 0.048%).

Because elevated organic concentrations were suspected in piezometer PZ-303-AS and because PZ-303-AS was drilled the closest of any piezometer to the MW-F2 area west of the asphalt plant LUST site, TPH and VOC analyses were substituted for TOC analysis. Table 3.11 lists the TPH and VOC results for the two alluvial soil samples collected from PZ-303-AS, as well as soil borings drilled specifically to identify the extent of potential petroleum impacts near MW-F2. Purgeable-range petroleum hydrocarbons and VOCs above the laboratory reporting limit were present only in SB-01, nearest to the MW-F2 area.

3.6 Uncertainty

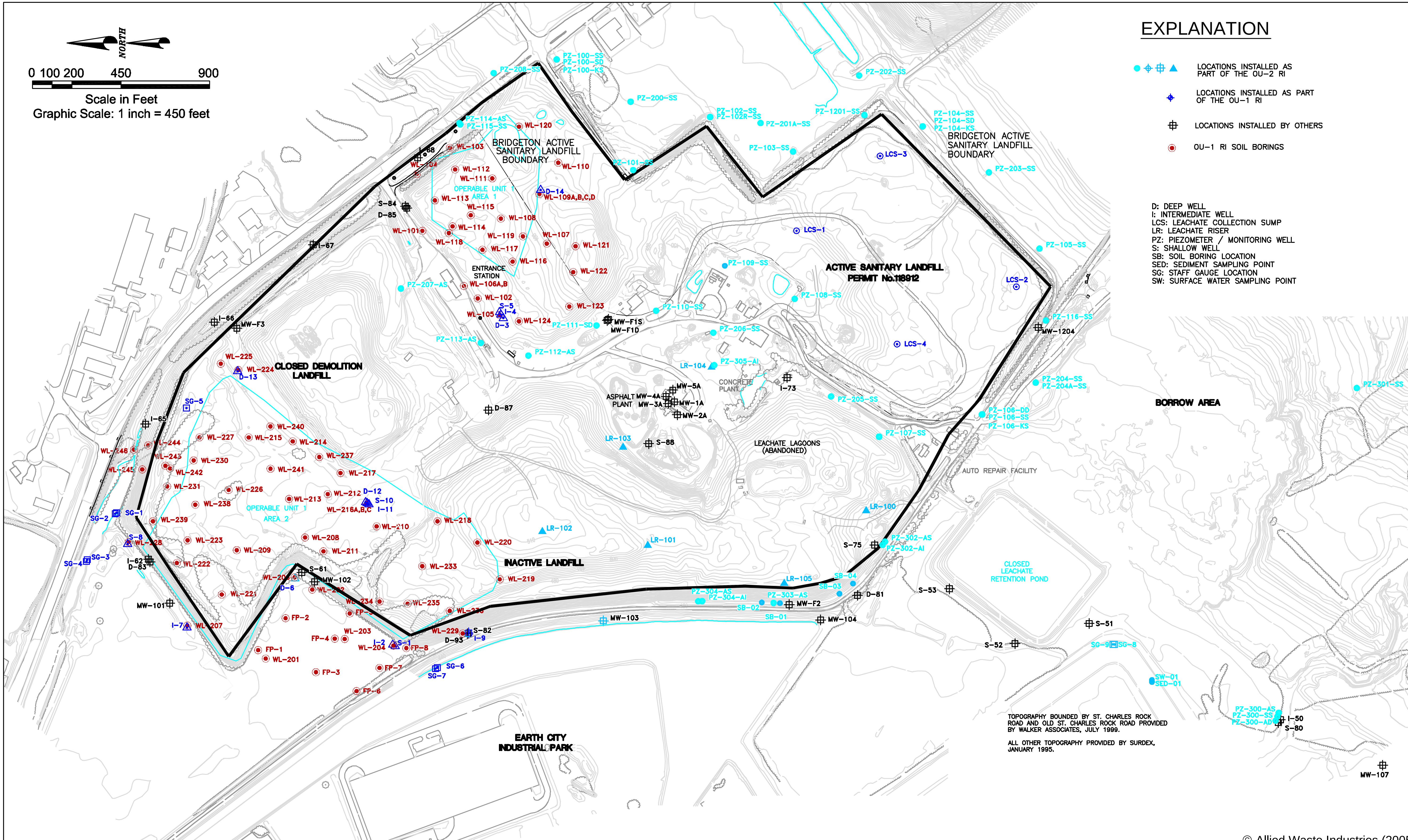
Because it is difficult to completely assess complex landfill contents, an element of uncertainty exists with regard to the completeness of the parameters detected. However, the containment presumptive remedy emphasizes the use of existing data to the degree possible and discourages characterization of landfill contents since it is presumed that the landfill will be contained (USEPA, 1991a). In keeping with these principles, a phased approach to sampling, like the sampling conducted as part of the West Lake Landfill Site Characterization, is appropriate.

3.7 Summary

The phased approach to site characterization is a site-specific strategy that frames the data collection effort within the context of determining whether a risk is present at a site rather than characterizing the nature and extent of all contamination at a landfill (USEPA, 1991a). The West Lake Landfill OU-2 RI and Site Characterization efforts sampled a variety of environmental media for landfill contaminants. Based on past experiences at landfill sites, groundwater contamination is likely to present a risk and thus trigger the need for action. Groundwater was the medium most extensively sampled as part of the West Lake Landfill Site Characterization and presents many parameters above detection limits, including, but not exclusive to, organics, metals and PCBs which will be further evaluated as part of this risk assessment.

Specifically, alluvial groundwater sampling identified five metals and conventional parameters (arsenic, barium, boron, iron and ammonia as N) which exhibited a maximum detection sample result that is 10 times or more greater than the background maximum concentration. The maximum concentration for each of these parameters was exhibited by piezometers PZ-303-AS or PZ-304-AS, which are located along the western side of the inactive landfill. Alluvial groundwater sampling also found VOCs (summarized in Table 3.6) and semi-volatile organic compounds. These results were expected, as the alluvial hydrogeologic unit is closest to the landfill contents. Groundwater sampling of the St. Louis/Upper Deep Salem and Deep Salem hydrogeologic units exhibited detected parameters largely consistent with background levels, with the exception of inconsistent detections of VOCs which largely consisted of benzene and acetone.

Other environmental media sampled and summarized above as part of the West Lake Landfill Site Characterization included soil, surface water, landfill gas and leachate. The results of the sampling are largely consistent with what could be expected in a landfill (i.e., landfill gas levels), or background (i.e., radionuclide levels, conventionals and most metals).



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West Lake Landfill OU-2
Bridgeton, Missouri

Figure 3
Environmental Sampling Locations

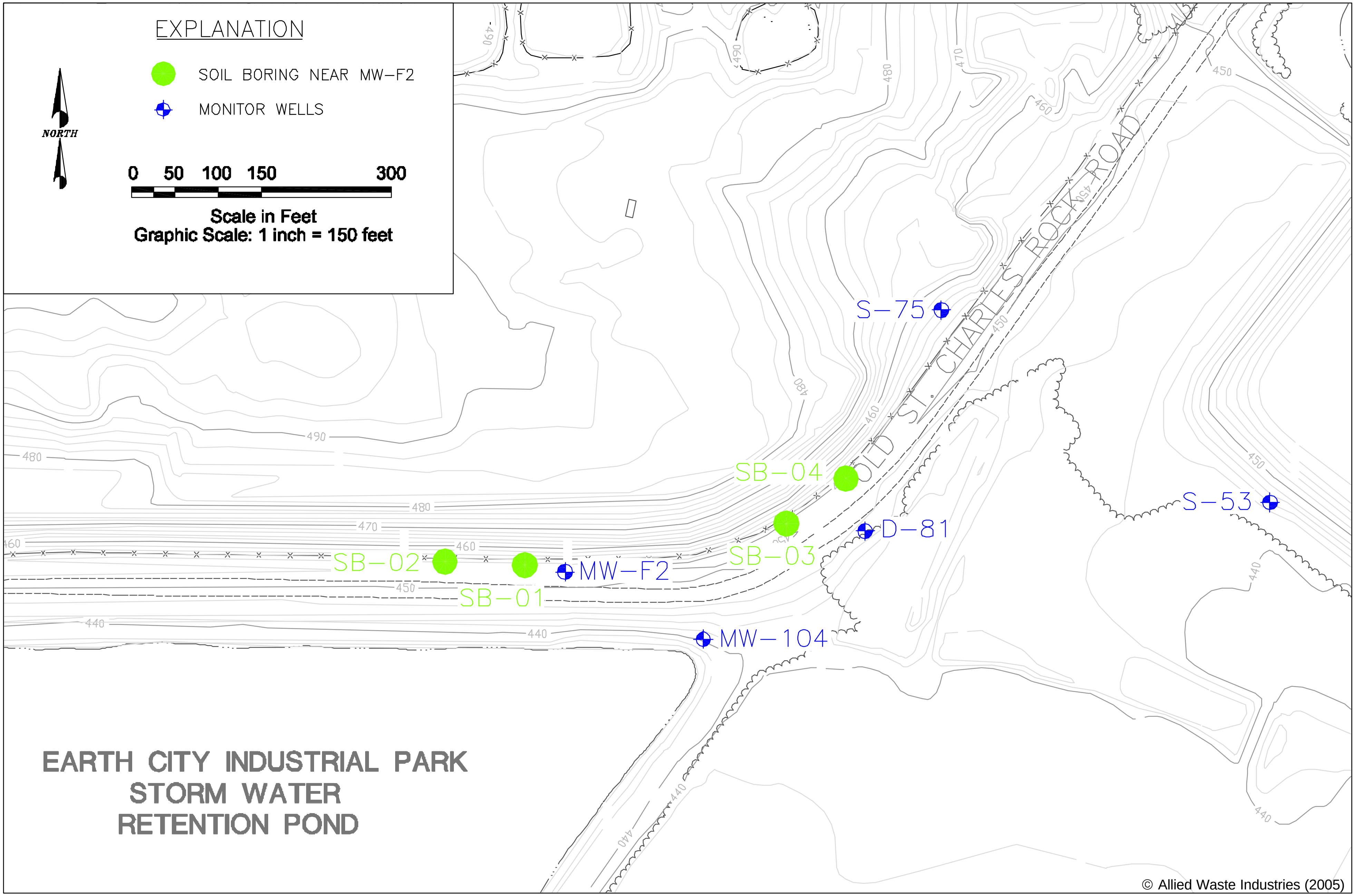

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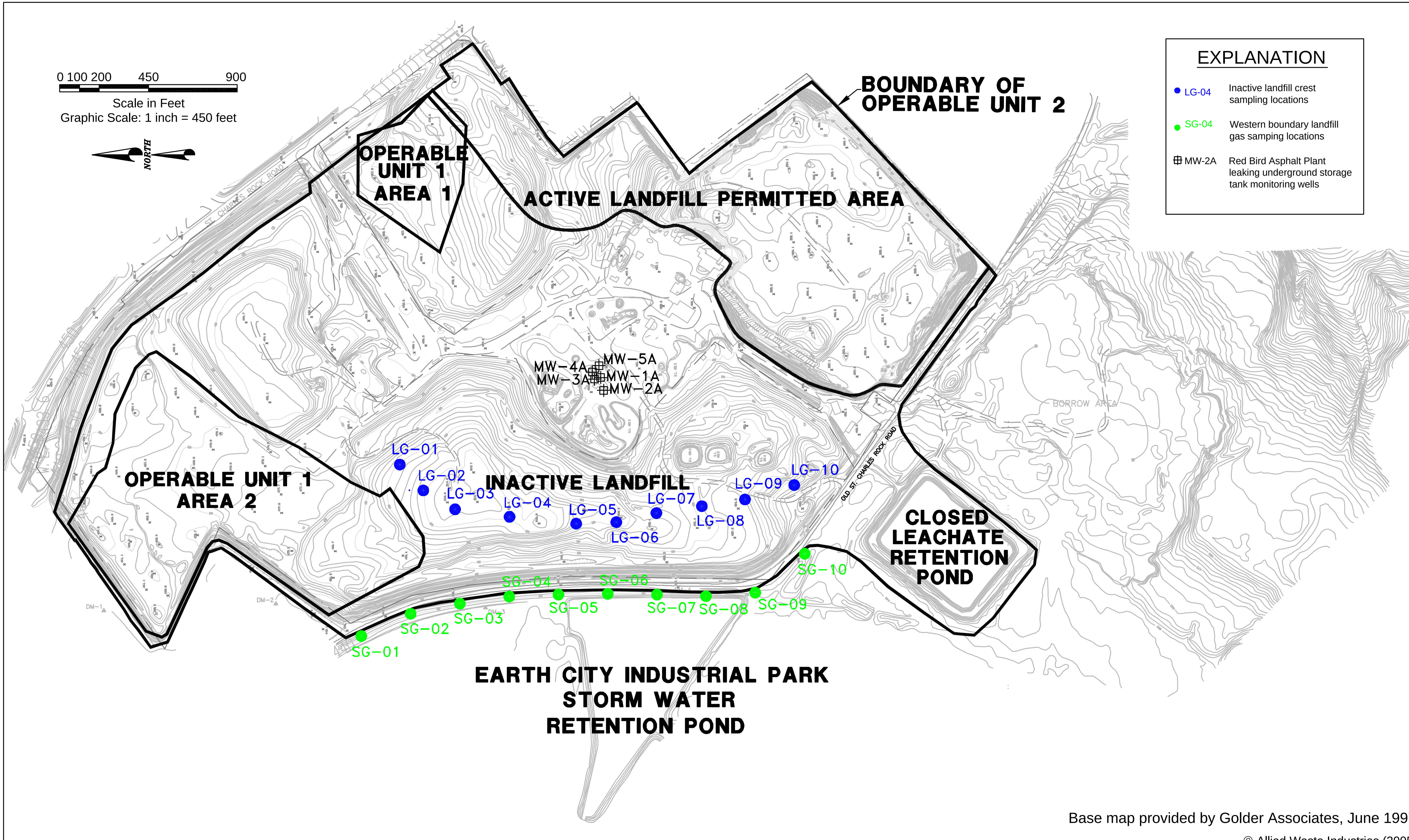
Figure 4
Soil Boring Locations



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Bridgeton, Missouri

Figure 5
Landfill Gas Sampling Locations

Table 3.1 Liquid Analyte List

Metals
Antimony (Dissolved)
Antimony (Total)
Arsenic (Dissolved)
Arsenic (Total)
Barium (Dissolved)
Barium (Total)
Beryllium (Dissolved)
Beryllium (Total)
Boron (Dissolved)
Boron (Total)
Cadmium (Dissolved)
Cadmium (Total)
Calcium (Dissolved)
Calcium (Total)
Chromium (Dissolved)
Chromium (Total)
Cobalt (Dissolved)
Cobalt (Total)
Copper (Dissolved)
Copper (Total)
Iron (Dissolved)
Iron (Total)
Lead (Dissolved)
Lead (Total)
Magnesium (Dissolved)
Magnesium (Total)
Manganese (Dissolved)
Manganese (Total)
Mercury (Dissolved)
Mercury (Total)
Nickel (Dissolved)
Nickel (Total)
Selenium (Dissolved)
Selenium (Total)
Silver (Dissolved)
Silver (Total)
Sodium (Dissolved)
Sodium (Total)
Thallium (Dissolved)
Thallium (Total)
Vanadium (Dissolved)
Vanadium (Total)
Zinc (Dissolved)
Zinc (Total)

Conventionals
Ammonia as N
Chemical Oxygen Demand
Chloride
Cyanide, total
Fluoride
Hardness, total
Nitrate/Nitrite
Phosphorus, total
Sulfate as SO4
Sulfide as S
Total Dissolved Solids
Total Organic Carbon

Radionuclides
Gross Alpha (Dissolved)
Gross Alpha (Total)
Gross Beta (Dissolved)
Gross Beta (Total)
Radium-226 (Dissolved)
Radium-226 (Total)
Uranium-234 (Dissolved)
Uranium-234 (Total)
Uranium-235/6 (Dissolved)
Uranium-235/6 (Total)
Uranium-238 (Dissolved)
Uranium-238 (Total)
Thorium-230 (Dissolved)
Thorium-230 (Total)

Volatiles/Organics
1,1,1,2-Tetrachloroethane
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethylene
1,2,3-Trichloropropane
1,2,4-Trichlorobenzene
1,2-cis-Dichloroethylene
1,2-Dibromo-3-chloropropane
1,2-Dibromoethane
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,2-trans-Dichloroethylene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
2-Chloronaphthalene
2-Chlorophenol
2-Hexanone
2-Methylnaphthalene
2-Nitrophenol
3,3'-Dichlorobenzidine
4,4'-DDD
4,4'-DDE
4,4'-DDT
4,6-Dinitro-o-cresol
4-Bromophenyl phenyl ether
4-Chlorophenyl phenyl ether
4-Nitrophenol
Acenaphthene
Acenaphthylene
Acetone
Acrylonitrile
Aldrin
alpha-BHC
alpha-Chlordane
Anthracene
Aroclor 1016
Aroclor 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Benzene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
beta-BHC
bis(2-Chloroethoxy)methane
bis(2-Chloroethyl)ether
bis(2-Chloroisopropyl)ether
bis(2-Ethylhexyl)phthalate
Bromochloromethane
Bromoform
Butyl Benzyl Phthalate
Carbazole
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chrysene
cis-1,3-Dichloropropylene
delta-BHC
Di-n-butyl phthalate
Di-n-octyl phthalate
Dibenzo(a,h)anthracene
Dibenzofuran
Dibromochloromethane
Dibromomethane
Dichlorobromomethane
Dieldrin
Diethyl phthalate
Dimethyl phthalate
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin aldehyde
Endrin ketone
Ethylbenzene
Fluoranthene
Fluorene
gamma-BHC (Lindane)
gamma-Chlordane
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno(1,2,3-cd)pyrene
Iodomethane
Isophorone
m+p-Cresols
m-Nitroaniline
Methoxychlor
Methyl bromide
Methyl chloride
Methyl ethyl ketone
Methyl-iso-butyl ketone
Methylene chloride
N-Nitrosodi-n-propylamine
N-Nitrosodiphenylamine
Naphthalene
Nitrobenzene
o-Cresol
o-Nitroaniline
p-Chloro-m-cresol
p-Chloroaniline
p-Nitroaniline
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
Styrene
Tetrachloroethylene
Toluene
Toxaphene
trans-1,3-Dichloropropylene
trans-1,4-Dichloro-2-butene
Trichloroethylene
Trichlorofluoromethane
Vinyl acetate
Vinyl chloride
Volatile Petroleum Hydrocarbons
Xylenes (Total)

Table 3.2 Background Bedrock Groundwater Quality Summary
PZ-300-SS, PZ-301-SS, PZ-204A-SS
(Page 1 of 2)

Parameter	Range of Background Concentrations (mg/L)
Metals	
Antimony (Dissolved)	<0.003 to 0.008
Antimony (Total)	<0.002 to 0.009
Arsenic (Dissolved)	<0.002 to 0.008
Arsenic (Total)	<0.002 to 0.007
Barium (Dissolved)	0.022 to 0.079
Barium (Total)	0.037 to 0.1
Beryllium (Dissolved)	<0.001 to <0.001
Beryllium (Total)	<0.001 to <0.001
Boron (Dissolved)	<0.1 to 0.636
Boron (Total)	<0.1 to 0.8
Cadmium (Dissolved)	<0.005 to <0.005
Cadmium (Total)	<0.005 to <0.005
Calcium (Dissolved)	40.1 to 66.9
Calcium (Total)	41.0 to 75.4
Chromium (Dissolved)	<0.01 to <0.01
Chromium (Total)	<0.01 to <0.01
Cobalt (Dissolved)	<0.02 to <0.02
Cobalt (Total)	<0.02 to <0.02
Copper (Dissolved)	<0.02 to <0.02
Copper (Total)	<0.02 to <0.02
Iron (Dissolved)	<0.04 to 0.665
Iron (Total)	<0.04 to 1.02
Lead (Dissolved)	<0.002 to <0.002
Lead (Total)	<0.002 to 0.003
Magnesium (Dissolved)	25.1 to 37.6
Magnesium (Total)	25.4 to 56.4
Manganese (Dissolved)	0.045 to 0.063
Manganese (Total)	0.045 to 0.064
Mercury (Dissolved)	<0.0002 to <0.0002
Mercury (Total)	<0.0002 to <0.0002
Nickel (Dissolved)	<0.040 to <0.040
Nickel (Total)	<0.040 to <0.040
Selenium (Dissolved)	<0.002 to <0.002
Selenium (Total)	<0.002 to <0.002
Silver (Dissolved)	<0.010 to <0.010
Silver (Total)	<0.010 to <0.010
Sodium (Dissolved)	30.1 to 153
Sodium (Total)	28.1 to 154
Thallium (Dissolved)	<0.002 to <0.002
Thallium (Total)	<0.002 to <0.002
Vanadium (Dissolved)	<0.010 to <0.010
Vanadium (Total)	<0.010 to <0.010

Zinc (Dissolved)	<0.030 to <0.030
Zinc (Total)	<0.030 to 0.133
Conventionals	
Ammonia as N	<0.1 to 0.2
Chemical Oxygen Demand	<15 to 50
Chloride	4 to 7
Cyanide, Total	<0.010 to <0.010
Fluoride	0.43 to 1.8
Hardness, Total	220 to 360
Nitrate/Nitrite	<0.1 to 0.2
Phosphorus, Total	0.04 to 1.5
Sulfate as SO4	20 to 73
Sulfide as S	<1 to 1
Total Dissolved Solids	432 to 640
Total Organic Carbon	<1 to 7
Radionuclides	
Gross Alpha (Dissolved)	<3.32 to 17.9±5.24
Gross Alpha (Total)	3.51±2.69 to 28.8±7.21
Gross Beta (Dissolved)	<3.72 to 9.28±3.86
Gross Beta (Total)	4.37±2.25 to 20.5±4.37
Radium-226 (Dissolved)	<0.43 to 1.42±0.563
Radium-226 (Total)	0.78±0.09 to 3.33±0.769
Uranium-234 (Dissolved)	0.89±0.28 to 8.2±1.37
Uranium-234 (Total)	0.80±0.26 to 9.78±1.81
Uranium-235/236 (Dissolved)	<0.141 to 0.769±0.449
Uranium-235/236 (Total)	<0.169 to 0.516±0.35
Uranium-238 (Dissolved)	0.50±0.20 to 3.36±0.89
Uranium-238 (Total)	0.25±0.13 to 4.55±1.25
Thorium-230 (Dissolved)	<0.502 to 0.29±0.17
Thorium-230 (Total)	<0.736 to 0.84±0.29

Table 3.3 Background Alluvial Groundwater Quality Summary
Monitoring Wells MW-107. S-80 and 1-50 and
Piezometers PZ-300-AS and PZ-300-AD
(Page 1 of 2)

Parameter	Range of Background Concentrations (mg/L)
Metals	
Antimony (Dissolved)	<0.003 to <0.003
Antimony (Total)	<0.002 to <0.003
Arsenic (Dissolved)	0.004 to 0.004
Arsenic (Total)	0.004 to 0.004
Barium (Dissolved)	0.152 to 0.178
Barium (Total)	0.152 to 0.182
Beryllium (Dissolved)	<0.001 to <0.001
Beryllium (Total)	<0.001 to <0.001
Boron (Dissolved)	<0.1 to <0.1
Boron (Total)	<0.1 to <0.1
Cadmium (Dissolved)	<0.005 to <0.005
Cadmium (Total)	<0.005 to <0.005
Calcium (Dissolved)	158 to 159
Calcium (Total)	131 to 176
Chromium (Dissolved)	<0.01 to <0.01
Chromium (Total)	<0.01 to 0.011
Cobalt (Dissolved)	<0.02 to <0.02
Cobalt (Total)	<0.02 to <0.02
Copper (Dissolved)	<0.02 to <0.02
Copper (Total)	<0.02 to <0.02
Iron (Dissolved)	3.33 to 4.06
Iron (Total)	1.98 to 2.83
Lead (Dissolved)	<0.002 to <0.002
Lead (Total)	<0.002 to <0.002
Magnesium (Dissolved)	56.4 to 58.0
Magnesium (Total)	41.6 to 57.8
Manganese (Dissolved)	3.09 to 3.32
Manganese (Total)	3.05 to 3.14
Mercury (Dissolved)	<0.0002 to <0.0002
Mercury (Total)	<0.0002 to <0.0002
Nickel (Dissolved)	<0.040 to <0.040
Nickel (Total)	<0.040 to <0.040
Selenium (Dissolved)	<0.002 to <0.002
Selenium (Total)	<0.002 to <0.002
Silver (Dissolved)	<0.010 to <0.010
Silver (Total)	<0.010 to <0.010
Sodium (Dissolved)	43.4 to 44.9
Sodium (Total)	35.4 to 73.0
Thallium (Dissolved)	<0.002 to <0.002
Thallium (Total)	<0.002 to <0.002
Vanadium (Dissolved)	<0.010 to <0.010

Vanadium (Total)	<0.010 to <0.010
Zinc (Dissolved)	<0.030 to <0.030
Zinc (Total)	<0.030 to <0.030

Conventionals

Ammonia as N	0.4 to 0.4
Chemical Oxygen Demand	<15 to 40
Chloride	130 to 215
Cyanide, Total	<0.010 to <0.010
Fluoride	0.27 to 0.36
Hardness, Total	660 to 700
Nitrate/Nitrite	<0.1 to <0.1
Phosphorus, Total	0.39 to 0.63
Sulfate as SO4	62 to 110
Sulfide as S	<1 to <1
Total Dissolved Solids	933 to 940
Total Organic Carbon	2 to 3

Radionuclides

Gross Alpha (Dissolved)	<3.03 to <8.19
Gross Alpha (Total)	<3.53 to 56.1±9.5
Gross Beta (Dissolved)	<3.94 to 6.02±3.00
Gross Beta (Total)	4.38±2.39 to 53.1±6.2
Radium-226 (Dissolved)	0.07±0.03 to 0.35±0.05
Radium-226 (Total)	<0.066 to 0.51±0.07
Uranium-234 (Dissolved)	0.25±0.13 to 0.88±0.26
Uranium-234 (Total)	0.32±0.15 to 0.99±0.31
Uranium-235/236 (Dissolved)	<0.10 to 0.16±0.11
Uranium-235/236 (Total)	<0.09 to 0.27±0.17
Uranium-238 (Dissolved)	<0.097 to 0.63±0.21
Uranium-238 (Total)	<0.26 to 1.19±0.35
Thorium-230 (Dissolved)	<0.63 to 0.93±0.30
Thorium-230 (Total)	<0.42 to 1.48±0.40

Table 3.4. Summary of Detected Parameters from St. Louis/Upper Salem Groundwater Sampling (Page 1 of 3)

Parameter	Range of Background Concentrations (mg/L)	Range of Detection Results (mg/L)	Frequency of Detection	Piezometer Exhibiting the Maximum Detection Concentration
Metals				
Antimony (Dissolved)	<0.003 to 0.008	<0.003 to 0.004	4/24	PZ-1201-SS
Antimony (Total)	<0.002 to 0.009	>0.003 to 0.007	4/24	PZ-102R-SS
Arsenic (Dissolved)	<0.002 to 0.008	<0.002 to 0.007	8/24	PZ-113-SS
Arsenic (Total)	0.002 to 0.007	<0.002 to 0.006	13/24	PZ-113-SS
Barium (Dissolved)	0.022 to 0.079	0.033 to 0.251	24/24	PZ-110-SS
Barium (Total)	0.037 to 0.1	0.054 to 0.252	24/24	PZ-110-SS
Boron (Dissolved)	<0.1 to 0.636	<0.1 to 0.282	5/24	PZ-110-SS
Boron (Total)	<0.1 to 0.80	<0.1 to 0.30	9/24	PZ-110-SS
Calcium (Dissolved)	40.1 to 66.9	49.6 to 219	24/24	PZ-110-SS
Calcium (Total)	41.0 to 75.4	60 to 214	25/25	PZ-110-SS
Chromium (Dissolved)	<0.010 to <0.010	<0.01 to 0.016	2/24	PZ-113-SS
Iron (Dissolved)	<0.04 to 0.665	<0.04 to 4.24	10/24	PZ-110-SS
Iron (Total)	<0.04 to 1.02	<0.04 to 5.87	23/24	PZ-110-SS
Magnesium (Dissolved)	25.1 to 37.6	26.3 to 80.0	24/24	PZ-110-SS
Magnesium (Total)	25.4 to 56.4	29.1 to 81	25/25	PZ-110-SS
Manganese (Dissolved)	0.045 to 0.063	<0.01 to 0.375	18/24	PZ-201A-SS
Manganese (Total)	0.045 to 0.064	0.017 to 0.528	24/24	PZ-201A-SS
Nickel (Dissolved)	<0.04 to <0.04	<0.04 to 0.048	1/24	PZ-110-SS
Nickel (Total)	<0.04 to <0.04	<0.04 to 0.055	2/24	PZ-110-SS
Selenium (Dissolved)	<0.002 to <0.002	<0.002 to 0.003	1/24	PZ-102R-SS
Selenium (Total)	<0.002 to <0.002	<0.002 to 0.003	2/24	PZ-102R-SS
Sodium (Dissolved)	30.1 to 153	11 to 114	24/24	PZ-110-SS
Sodium (Total)	28.1 to 154	11 to 115	25/25	PZ-110-SS
Zinc (Dissolved)	<0.030 to <0.030	<0.03 to 0.044	3/24	PZ-110-SS
Zinc (Total)	<0.03 to 0.133	<0.03 to 0.227	19/24	PZ-110-SS
Conventionals				
Ammonia as N	<0.1 to 0.2	<0.1 to 0.8	11/24	PZ-100-SS
Chemical Oxygen Demand	<15 to 50	<15 to 81	15/25	PZ-110-SS

Chloride	4 to 7	<3 to 215	23/24	PZ-110-SS
Fluoride	0.43 to 1.8	0.49 to 2.7	24/24	PZ-113-SS

Parameter	**Range of Background Concentrations (mg/L)**	**Range of Detection Results (mg/L)**	**Frequency of Detection**	**Piezometer Exhibiting the Maximum Detection Concentration**
Conventionals, cont.				
Hardness, total	220 to 360	290 to 900	25/25	PZ-110-SS
Nitrate/Nitrite	<0.1 to 0.2	<0.1 to 0.2	7/25	PZ-1201-SS
Phosphorus, total	0.04 to 1.5	0.06 to 1.6	23/24	PZ-1201-SS
Sulfate as SO4	20 to 73	26 to 141	25/25	PZ-102R-SS
Sulfide as S	<1 to 1	<1 to 4.3	26/26	PZ-102R-SS
Total Dissolved Solids	432 to 640	364 to 1418	24/24	PZ-110-SS
Total Organic Carbon	<1 to 7	<1 to 23	16/24	PZ-110-SS
Radionuclides	**(pCi/L)**	**(pCi/L)**		
Gross Alpha (Dissolved)	<3.32 to 17.9 +/- 5.24	<2.97 to 17.4 +/- 5	18/25	PZ-100-SS
Gross Alpha (Total)	3.51 +/- 2.69 to 28.8 +/- 7.21	<4.61 to 29.3 +/- 11.9	19/25	PZ-1201-SS
Gross Beta (Dissolved)	<3.72 to 9.28 +/- 3.86	<3.6 to 19 +/- 2.28	22/25	PZ-1201-SS
Gross Beta (Total)	4.37 +/- 2.25 to 20.5 +/- 4.37	<4.49 to 35.2 +/- 10.7	17/25	PZ-1201-SS
Radium-226 (Dissolved)	<0.43 to 1.42 +/- 0.563	<0.412 to 2.53 +/- 0.733	22/25	PZ-106-SS
Radium-226 (Total)	0.78 +/- 0.09 to 3.33 +/- 0.769	<0.426 to 6.33 +/- 1.26	25/25	PZ-106-SS
Uranium-234 (Dissolved)	0.89 +/- 0.28 to 8.2 +/- 1.37	<0.343 to 12.7 +/- 1.46	24/25	PZ-100-SS
Uranium-234 (Total)	0.80 +/- 0.26 to 9.78 +/- 1.81	0.202 +/- 0.146 to 20 +/- 1.39	23/25	PZ-104-SS
Uranium-235/6 (Dissolved)	<0.141 to 0.769 +/- 0.449	<0.151 to 1.25 +/- 0.851	5/25	PZ-201A-SS
Uranium-235/6 (Total)	<0.169 to 0.516 +/- 0.35	<0.123 to 0.746 +/- 0.418	6/25	PZ-100-SS
Uranium-238 (Dissolved)	0.50 +/- 0.20 to 3.36 +/- 0.888	<0.151 to 6.27 +/- 1.2	24/25	PZ-100-SS
Uranium-238 (Total)	0.25 +/- 0.13 to 4.55 +/- 1.25	<0.134 to 6.39 +/- 1.15	21/25	PZ-100-SS
Thorium-230 (Dissolved)	<0.502 to 0.29 +/- 0.17	<0.442 to 0.934 +/- 0.392	8/25	PZ-206-SS
Thorium-230 (Total)	<0.736 to 0.84 +/- 0.29	<0.535 to 2.41 +/- 1.1	13/25	PZ-1201-SS
Volatiles/Organics				
1,2-cis-Dichloroethylene	<0.002 to <0.002	<0.002 to 0.0024	1/24	GW-110-SS
Acetone	<0.005 to <0.005	<0.005 to 0.005	1/24	GW-1201-SS
Benzene	<0.002 to <0.002	<0.002 to 0.011	3/24	GW-1201-SS
gamma-Chlordane	<0.00005 to <0.00005	<0.00005 to <0.000051	1/24	GW-100-SS
Xylenes (Total)	<0.002 to <0.002	<0.002 to 0.67	4/24	GW-301-SS

Table 3.5 Summary of Detected Parameters from Deep Salem Groundwater Sampling
(Page 1 of 2)

Parameter	Range of Background Concentrations (mg/L)	Range of Detection Results (mg/L)	Frequency of Detection	Piezometer Exhibiting the Maximum Detection Concentration
Metals				
Arsenic (Dissolved)	<0.002 to 0.008	<0.002 to 0.002	2/11	PZ-100-SD
Arsenic (Total)	0.002 to 0.007	<0.002 to 0.002	3/11	PZ-100-SD; PZ-106-SD
Barium (Dissolved)	0.022 to 0.079	0.045 to 0.273	11/11	PZ-100-SD
Barium (Total)	0.037 to 0.1	0.05 to 0.291	11/11	PZ-100-SD
Calcium (Dissolved)	40.1 to 66.9	75.8 to 119	11/11	PZ-104-SD
Calcium (Total)	41.0 to 75.4	81.2 to 116	11/11	PZ-104-SD
Iron (Dissolved)	<0.04 to 0.665	<0.04 to 0.945	7/11	MW-1204
Iron (Total)	<0.04 to 1.02	0.119 to 2.09	11/11	PZ-100-SD
Magnesium (Dissolved)	25.1 to 37.6	34.0 to 53.9	11/11	PZ-111-SD
Magnesium (Total)	25.4 to 56.4	34.3 to 53.4	11/11	PZ-111-SD
Manganese (Dissolved)	0.045 to 0.063	0.016 to 0.238	11/11	PZ-106-SD
Manganese (Total)	0.045 to 0.064	0.017 to 0.332	11/11	PZ-100-SD
Sodium (Dissolved)	30.1 to 153	11 to 59.9	11/11	PZ-106-SD
Sodium (Total)	28.1 to 154	11 to 59.1	11/11	PZ-106-SD
Zinc (Dissolved)	<0.030 to <0.030	<0.03 to 0.053	2/11	PZ-111-SD
Zinc (Total)	<0.03 to 0.133	<0.03 to 0.103	9/11	PZ-111-SD
Conventionals				
Ammonia as N	<0.1 to 0.2	<0.1 to 0.5	7/11	PZ-100-SD; PZ-106-SD
Chemical Oxygen Demand	<15 to 50	<15 to 92	3/11	PZ-106-SD
Chloride	4 to 7	<3 to 56	10/11	PZ-104-SD
Fluoride	0.43 to 1.8	0.77 to 2.4	11/11	PZ-1204-SD
Hardness, total	220 to 360	340 to 500	11/11	PZ-303-AS
Nitrate/Nitrite	<0.1 to 0.2	<0.1 to 0.3	3/11	PZ-106-SD
Phosphorus, total	0.04 to 1.5	<0.01 to 0.37	9/11	PZ-303-AS
Sulfate as SO4	20 to 73	10 to 120	11/11	PZ-106-SD
				PZ-111-SD; MW-1204
Sulfide as S	<1 to 1	<1 to 1	4/11	PZ-106-SD;
Total Dissolved Solids	432 to 640	340 to 665	11/11	PZ-106-SD
Total Organic Carbon	<1 to 7	<1 to 26	5/11	PZ-106-SD

Parameter	Range of Background Concentrations	Range of Detection Results	Frequency of Detection	Piezometer Exhibiting the Maximum Detection Concentration
Radionuclides	**(pCi/L)**	**(pCi/L)**		
Gross Alpha (Dissolved)	<3.32 to 17.9 +/- 5.24	<3.13 to 10.8 +/- 4.98	3/10	PZ-106-SD
	(mg/L)	**(mg/L)**		
Radionuclides, cont.	**(pCi/L)**	**(pCi/L)**		
Gross Alpha (Total)	3.51 +/- 2.69 to 28.8 +/- 7.21	<4.18 to 12.3 +/- 5.4	5/10	PZ-106-SD
Gross Beta (Dissolved)	<3.72 to 9.28 +/- 3.86	<4.14 to 6.73 +/- 2.19	3/10	PZ-100-SD
Gross Beta (Total)	4.37 +/- 2.25 to 20.5 +/- 4.37	<3.56 to 9.53 +/- 3.61	4/10	MW-1204
Radium-226 (Dissolved)	<0.43 to 1.42 +/- 0.563	<0.706 to 2.38 +/- 0.729	9/10	MW-1204
Radium-226 (Total)	0.78 +/- 0.09 to 3.33 +/- 0.769	<0.678 to 2.98 +/- 0.898	9/10	PZ-100-SD
Uranium-234 (Dissolved)	0.89 +/- 0.28 to 8.2 +/- 1.37	<0.283 to 2.32 +/- 0.541	9/10	PZ-106-SD
Uranium-234 (Total)	0.80 +/- 0.26 to 9.78 +/- 1.81	<0.628 to 15.3 +/- 1.82	8/10	MW-1204
Uranium-235/6 (Dissolved)	<0.141 to 0.769 +/- 0.449	<0.13 to 0.315 +/- 0.176	1/10	PZ-303-AS
Uranium-235/6 (Total)	<0.169 to 0.516 +/- 0.35	<0.159 to 0.744 +/-0.416	1/10	MW-1204
Uranium-238 (Dissolved)	0.50 +/- 0.20 to 3.36 +/- 0.888	<0.283 to 2.57 +/- 1.14	7/10	PZ-106-SD
Uranium-238 (Total)	0.25 +/- 0.13 to 4.55 +/- 1.25	<0.346 to 6.9 +/- 1.2	9/10	MW-1204
Thorium-230 (Dissolved)	<0.502 to 0.29 +/- 0.17	<0.283 to 1.05 +/- 0.326	4/10	PZ-100-SD
Thorium-230 (Total)	<0.736 to 0.84 +/- 0.29	<0.473 to 0.845 +/- 0.288	3/10	PZ-100-SD
Volatiles/Organics				
Benzene	<0.002 to <0.002	<0.002 to 0.013	1/11	GW-111-SD
Volatile Petroleum Hydrocarbons	<0.00005 to <0.00005	<0.00005 to 0.53	1/11	GW-111-SD
Xylenes (Total)	<0.002 to <0.002	<0.002 to 0.67	1/11	GW-1204-SD-D

Table 3.6 Volatile organic compounds in PZ-303-AS, PZ-304-AS, PZ-304-AI and MW-103 (Alluvial Groundwater Sampling)

	Round 1				Round 2			
Compounds	PZ-303-AS	PZ-304-AS	PZ-304-AI	MW-103	PZ-303-AS	PZ-304-AS	PZ-304-AI	MW-103
Acetone	***0.009***	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Benzene	***0.078***	***0.005***	***0.010***	<0.002	***0.078***	***0.0062***	***0.011***	<0.002
Bis(2-ethylhexyl) phthalate	<0.002	<0.002	<0.002	***0.046***	<0.002	<0.002	<0.002	<0.002
Chlorobenzene	<0.002	***0.008***	<0.002	<0.002	<0.002	***0.0087***	<0.002	<0.002
Chloroethane	***0.013***	<0.002	<0.002	<0.002	***0.011***	<0.002	<0.002	<0.002
1,2-dichloroethane	***0.002***	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,2-dichlorobenzene	<0.002	<0.002	<0.002	<0.002	***0.0038***	<0.002	<0.002	<0.002
1,4-dichlorobenzene	<0.002	***0.012***	***0.003***	<0.002	***0.0034***	***0.012***	***0.0033***	<0.002
1,1-dichloroethane	<0.002	***0.002***	<0.002	<0.002	***0.033***	<0.002	<0.002	<0.002
1,1-dichloroethylene	<0.002	<0.002	<0.002	<0.002	<0.002	***0.003***	<0.002	<0.002
1,2-cis-dichloroethylene	***0.008***	***0.006***	***0.011***	***0.004***	***0.0081***	***0.0067***	***0.013***	***0.0044***
1,2-trans-dichloroethylene	***0.002***	<0.002	<0.002	<0.002	***0.0025***	<0.002	<0.002	<0.002
Ethylbenzene	***0.120***	<0.002	<0.002	<0.002	***0.113***	<0.002	<0.002	<0.002
MEK	***0.007***	<0.002	<0.002	<0.002	<0.005	<0.005	<0.005	<0.005
Styrene	***0.006***	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Toluene	***0.400***	<0.002	<0.002	<0.002	***0.380***	<0.002	<0.002	<0.002
Vinyl Chloride	***0.012***	***0.012***	***0.010***	<0.002	***0.026***	***0.0076***	***0.0062***	<0.002
Total Xylenes	***0.670***	<0.002	<0.002	<0.002	***0.530***	<0.002	<0.002	<0.002

Sample results above reporting limit are shown in ***boldface/italics*** type.

Table 3.7 Summary of Detected Parameters from Alluvial Groundwater Sampling (Page 1 of 3)

Parameter	Range of Background Concentrations (mg/L)	Range of Detection Results (mg/L)	Frequency of Detection	Piezometer Exhibiting the Maximum Detection Concentration
Metals				
Antimony (Total)	<0.003 to <0.003	<0.003 to 0.004	1/19	PZ-113-AD
Arsenic (Dissolved)	0.004 to 0.004	<0.002 to 0.094	13/19	PZ-304-AS
Arsenic (Total)	0.004 to 0.004	<0.002 to 0.087	15/19	PZ-303-AS
Barium (Dissolved)	0.152 to 0.178	0.089 to 1.24	19/19	PZ-304-AS
Barium (Total)	0.152 to 0.182	0.091 to 1.23	19/19	PZ-304-AS
Boron (Dissolved)	<0.1 to <0.1	<0.1 to 0.831	13/19	PZ-304-AS
Boron (Total)	<0.1 to <0.1	<0.1 to 0.847	13/19	PZ-304-AS
Calcium (Dissolved)	158 to 159	112 to 300	19/19	PZ-303-AS
Calcium (Total)	131 to 176	103 to 290	24/24	PZ-303-AS
Chromium (Total)	<0.010 to 0.011	<0.010 to 0.017	3/19	PZ-303-AS
Iron (Dissolved)	3.33 to 4.06	<0.04 to 92	18/19	PZ-303-AS
Iron (Total)	1.98 to 2.83	0.063 to 90.1	19/19	PZ-303-AS
Magnesium (Dissolved)	54.6 to 58.0	38.3 to 89.0	19/19	PZ-303-AS
Magnesium (Total)	41.6 to 57.8	39.8 to 84.3	24/24	PZ-303-AS
Manganese (Dissolved)	3.09 to 3.32	0.017 to 6.54	19/19	PZ-113-AS
Manganese (Total)	3.05 to 3.14	0.077 to 6.39	19/19	PZ-113-AS
Nickel (Dissolved)	<0.04 to <0.04	<0.04 to 0.04	1/19	PZ-304-AS
Nickel (Total)	<0.04 to <0.04	<0.04 to 0.044	2/19	PZ-304-AS
Selenium (Dissolved)	<0.002 to <0.002	<0.002 to 0.024	1/19	MW-103
Selenium (Total)	<0.002 to <0.002	<0.002 to 0.018	2/19	MW-103
Sodium (Dissolved)	43.4 to 44.9	12.5 to 197	19/19	PZ-304-AS
Sodium (Total)	35.4 to 73.0	12.8 to 206	24/24	PZ-304-AS
Zinc (Total)	<0.030 to <0.030	<0.030 to 0.056	2/19	PZ-113-AS
Conventionals				
Ammonia as N	0.4 to 0.4	<0.1 to 56.1	18/19	PZ-304-AS
Chemical Oxygen Demand	<15 to 40	<15 to 108	14/24	PZ-303-AS
Chloride	130 to 215	17 to 299	24/24	PZ-304-AS
Fluoride	0.27 to 0.36	<0.25 to 0.73	14/19	PZ-304-AS

Hardness, total	660 to 700	470 to 1100	19/19	PZ-303-AS
Nitrate/Nitrite	<0.1 to <0.1	<0.1 to 0.3	NR	MW-103

Parameter	Range of Background Concentrations (mg/L)	Range of Detection Results (mg/L)	Frequency of Detection	Piezometer Exhibiting the Maximum Detection Concentration
Conventionals, cont.				
Phosphorus, total	0.39 to 0.63	0.01 to 1.5	19/19	PZ-303-AS
Sulfate as SO4	62 to 110	<2 to 67	22/24	MW-103
Sulfide as S	<1 to <1	<1 to 1	5/19	MW-103
Total Dissolved Solids	933 to 940	86 to 1396	19/19	PZ-303-AS
Total Organic Carbon	2 to 3	3 to 30	23/23	PZ-304-AS
Radionuclides	**(pCi/L)**	**(pCi/L)**		
Gross Alpha (Dissolved)	<3.03 to <8.19	<6.22 to 9.83+/-3.22	1/23	MW-103
Gross Alpha (Total)	<3.53 to 56.1 +/-9.5	<7.27 to 9.61+/-6.23	4/22	PZ-304-Al
Gross Beta (Dissolved)	<3.94 to 6.02 +/-3.00	9.2+/-2.12 to 49.2+/-8.33	18/24	PZ-304-AS
Gross Beta (Total)	4.38 +/-2.49 to 53.1 +/-6.2	<7.21 to 49.5+/-7.24	19/24	PZ-304-AS
Radium-226 (Dissolved)	0.069+/-0.029 to 0.35+/-0.05	<0.415 to 1.39+/-0.6	23/24	PZ-113-AD
Radium-226 (Total)	<0.066 to 0.51+/-0.07	<0.419 to 2.31+/-0.803	18/23	PZ-113-AD
Uranium-234 (Dissolved)	0.25+/-0.13 to 0.88+/-0.26	<0.275 to 3.71+/-0.969	14/21	MW-103
Uranium-234 (Total)	0.32+/-0.15 to 0.99+/-0.31	<0.261 to 4.18+/-1	17/23	MW-103
Uranium-235/6 (Dissolved)	<0.10 to 0.16+/-0.11	<0.139 to <0.595	1/15	PZ-303-AS
Uranium-235/6 (Total)	<0.09 to 0.27+/-0.17	<0.136 to <0.623	2/15	PZ-304-Al
Uranium-238 (Dissolved)	<0.097 to 0.63+/-0.21	<0.139 to 4.17+/-0.969	14/21	MW-103
Uranium-238 (Total)	<0.258 to 1.19+/-0.35	<0.155 to 3.67 +/-0.906	17/21	MW-103
Thorium-230 (Dissolved)	<0.627 to 0.93+/-0.30	<0.523 to 0.964+/-0.435	10/22	PZ-304-Al
Thorium-230 (Total)	<0.415 to 1.48+/-0.40	<0.447 to 1.21+/-0.374	11/23	PZ-303-AS
Volatiles/Organics				
1,1-Dichloroethane	<0.002 to <0.002	<0.002 to 0.033	4/21	PZ-303-AS
1,1-Dichloroethylene	<0.002 to <0.002	<0.002 to 0.003	1/21	PZ-304-AS
1,2-cis-Dichloroethylene	0.004 to 0.0044	<0.002 to 0.013	10/19	PZ-304-AI
1,2-Dichlorobenzene	<0.002 to <0.002	<0.002 to 0.0038	1/19	PZ-303-AS
1,2-Dichloroethane	<0.002 to <0.002	<0.002 to 0.002	1/21	PZ-303-AS
1,2-trans-Dichloroethylene	<0.002 to <0.002	<0.002 to 0.0025	2/19	PZ-303-AS
1,4-Dichlorobenzene	<0.002 to <0.002	<0.002 to 0.012	7/19	PZ-304-AS
2,4-Dimethylphenol	<0.01 to <0.01	<0.01 to 0.086	2/19	PZ-303-AS

Parameter	Range of Background Concentrations (mg/L)	Range of Detection Results (mg/L)	Frequency of Detection	Piezometer Exhibiting the Maximum Detection Concentration
2-Methylnaphthalene	<0.01 to <0.01	<0.01 to 0.015	1/19	PZ-303-AS
Volatiles/Organics, cont.				
Acetone	<0.005 to <0.005	<0.005 to 0.009	1/21	PZ-303-AS
Benzene	<0.002 to <0.002	<0.002 to 0.078	8/21	PZ-303-AS
bis(2-Ethylhexyl)phthalate	<0.006 to <0.006	<0.006 to 0.046	1/19	PZ-103-D (MW-103)
Chlorobenzene	<0.002 to <0.002	<0.002 to 0.0087	4/21	PZ-304-AS
Chloroethane	<0.002 to <0.002	<0.002 to 0.013	2/21	PZ-303-AS
Dibenzo(a,h)anthracene	<0.0002 to <0.0002	<0.0002 to 0.002	3/19	PZ-107-D (MW-107)
Ethylbenzene	<0.002 to <0.002	<0.002 to 0.12	3/21	PZ-303-AS
Indeno(1,2,3-cd)pyrene	<0.00005 to <0.00005	<0.00005 to 0.00015	1/19	PZ-107-D (MW-107)
m+p-Cresols	<0.01 to <0.01	<0.01 to 0.016	1/19	PZ-303-AS
Methyl ethyl ketone	<0.005 to <0.005	<0.005 to 0.007	1/21	PZ-303-AS
Naphthalene	<0.01 to <0.01	<0.01 to 0.032	2/19	PZ-303-AS
o-Cresol	<0.01 to <0.01	<0.01 to 0.022	2/19	PZ-303-AS
Styrene	<0.002 to <0.002	<0.002 to 0.006	0/21	PZ-303-AS
Toluene	<0.002 to <0.002	<0.002 to 0.4	3/21	PZ-303-AS
trans-1,3-Dichloropropylene	<0.002 to <0.002	<0.002 to 0.008	1/21	PZ-303-AS
Vinyl chloride	<0.001 to <0.001	<0.001 to 0.026	8/21	PZ-303-AS
Volatile Petroleum Hydrocarbons	<0.00005 to <0.00005	<0.00005 to 0.53	7/21	PZ-304-AI
Xylenes (Total)	<0.002 to <0.002	<0.002 to 0.67	4/21	PZ-303-AS

NR: Not Reported

Table 3.8 West Lake Landfill Soil Gas Screening Results

Location Oxygen	PID (ppm)	Percent Oxygen	Percent Lower Explosion Limit	Hydrogen Sulfide (ppm)
SG-01	0.0	20.8	0	0.0
SG-02	0.0	18.9	0	0.0
SG-03	7.6	14.4	2	0.0
SG-04	0.0	18.7	0	0.0
SG-05	10.1	18.3	0	0.0
SG-06	0.0	20.6	0	0.0
SG-07	0.0	20.7	0	0.0
SG-08	0.0	18.8	130	0.0
SG-09	0.0	14.0	0	0.0
SG-10	0.0	18.9	0	0.0

Table 3.9 West Lake Inactive Landfill Gas Concentrations

	Sampling Location										
Compound	**LG-01**	**LG-02**	**LG-03**	**LG-04**	**LG-05**	**LG-06**	**LG-07**	**LG-08**	**LG-09**	**LG-10**	**LG-1201-SS**
1,2,4-Trimethylbenzene	ND	ND	***2.9***	***2.3***	***260***	***2.6***	ND	ND	ND	***44***	ND
1,2-cis-Dichloroethylene	ND	ND	ND	***7.1***	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorotetrafluoroethane	***410***	ND	***140***	***180***	ND	***0.88***	***140***	***520***	ND	***1.9***	ND
1,3,5-Trimethlybenzene	ND	ND	ND	ND	***68***	ND	ND	ND	ND	***24***	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	***66***	ND	ND	ND	ND	***12***	ND
4-Ethyltoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	***46***	ND
Acetone	***150***	ND	***21***	***32***	***24000***	***40***	ND	***430***	ND	***84***	***18***
Benzene	***180***	ND	***110***	***92***	ND	***1.3***	ND	***410***	***190***	***81***	***2.2***
Carbon disulfide	***130***	ND	ND	***22***	ND	ND	ND	ND	ND	ND	***26***
Chlorobenzene	ND	ND	ND	ND	***1100***	ND	***280***	***150***	ND	***670***	ND
Chloroethane	***250***	ND	***120***	***87***	ND	ND	ND	***110***	ND	ND	ND
Dichlorodifluoromethane	***760***	***32***	***46***	***98***	ND	***1.6***	***230***	***600***	***78***	***2***	ND
Ethylbenzene	ND	ND	***7.2***	***5***	***210***	ND	ND	***52***	ND	***240***	***1.2***
m + p Xylenes	ND	ND	***4***	***6.6***	***360***	***2.3***	***100***	***130***	***22***	***640***	***5.4***
Methyl chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	***12***
Methyl ethyl ketone	ND	ND	ND	ND	ND	ND	ND	***180***	ND	***81***	***34***
Methylene chloride	***13***	ND	***4.1***	***5.8***	ND	ND	***61***	***22***	***17***	***1.7***	***1.6***
o-Xylene	ND	ND	ND	ND	***200***	***1.4***	ND	***49***	ND	***270***	***2***
Toluene	***1200***	ND	***5.8***	***13***	ND	***2.3***	ND	***200***	***34***	***210***	***4.2***
Trichlorofluoromethane	***14***	ND	ND	ND	ND	ND	ND	ND	ND	***20***	ND
Vinyl chloride	***120***	ND	***61***	***76***	ND	***0.9***	ND	***740***	***100***	ND	ND

Notes

Results are in ppbv.

Samples above the detection limit are ***boldface/italic*** type.

ND equals NOT DETECTED

Table 3.10 Organic Compounds Detected in Leachate

Compound	Active Sanitary Landfill Leachate LCS-1	LCS-2	LCS-3	LCS-4	Inactive Landfill Leachate LR-100	LR-103	LR-104	LR-105
Acetone	***1.2***	***0.65***	***0.038***	***0.61***	<0.010	<0.010	<0.010	***0.04***
Benzene	<0.5	***0.009***	<0.005	<0.005	<0.005	<0.005	<0.005	***0.007***
Chlorobenzene	<0.5	***0.035***	***0.029***	***0.011***	***0.044***	<0.005	<0.005	***0.74***
1,4-Dichlorobenzene	<0.5	***0.081***	***0.009***	***0.056***	***0.01***	<0.005	<0.005	***0.068***
Ethylbenzene	<0.5	***0.049***	***0.023***	***0.07***	***0.012***	<0.005	<0.005	***0.089***
2-Hexanone	<1	***0.1***	<0.010	***0.18***	<0.010	<0.010	<0.010	<0.010
Methyl Ethyl Ketone	***3***	***1.3***	***0.11***	***2.6***	<0.010	<0.010	<0.010	<0.010
Methyl iso-butyl Ketone	<1	***0.08***	<0.010	***0.076***	<0.010	<0.010	<0.010	<0.010
Styrene	<0.5	***0.005***	<0.005	***0.006***	<0.005	<0.005	<0.005	<0.005
Toluene	<0.5	***0.097***	***0.15***	***0.12***	<0.005	<0.005	<0.005	***0.007***
Total Xylenes	<0.5	***0.14***	***0.035***	***0.17***	***0.057***	<0.005	<0.005	***0.43***
M+P Cresol	***1.9***	***0.95***	***0.077***	***0.26***	<0.010	<0.010	<0.010	R
2,4-Dimethylphenol	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	***0.082***
Bis(2-ethylhexyl)phthalate	***0.019***	***0.022***	***0.017***	<0.010	***0.12***	<0.010	<0.010	***0.036***
Diethyl phthalate	***0.033***	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dimethyl phthalate	***0.012***	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenol	***0.29***	***0.16***	<0.010	***0.017***	<0.010	<0.010	<0.010	R
Naphthalene	<0.010	<0.010	<0.010	<0.010	***0.011***	<0.010	<0.010	<0.010
Volatile Petroleum Hydrocarbons	***0.41***	***0.4***	***0.12***	***0.48***	***0.17***	<0.05	<0.05	***0.95***
Petroleum Hydrocarbons (Diesel)	***79***	***6.9***	***2.2***	***0.22***	***2.2***	***0.63***	***0.08***	***4.4***

Notes:
All results in mg/L
R: Data point rejected during data evaluation
Results above reporting limit are shown in ***boldface/italic*** type
Inactive landfill leachate riser LR-101 was not installed due to the absence of leachate at this location
Inactive landfill leachate riser LR-102 was not sampled due to minimal (<6 inches) liquid thickness

Table 3.11 Alluvial Soil Total Petroleum Hydrocarbon and VOC Results - Piezometer PZ-300-AS; Soil Borings SB-01 Through SB-04.

Sampling Location	TPH Purgeable Range (mg/kg)	TPH Extractable Range (mg/kg)	VOCs (mg/kg)
PZ-303-AS (17 ft)	2,000	12,000	Toluene (5.3) Ethylbenzene (10) Total Xylenes (54)
PZ-303-AS (25-25.5 ft)	160	160,	Total Xylenes (0.82)
SB-01 (16-18 ft)	6,700	15,000	Toluene (310) Ethylbenzene (24) Total Xylenes (120)
SB-02 (4-6 ft)	<0.1	32	ND
SB-02 (14-16 ft)	<0.1	24	ND
SB-03 (6-8 ft)	<0.1	23	ND
SB-03 (10-12 ft)	<0.1	<10	ND
SB-04 (8-10 ft)	<0.1	<10	ND

Notes:
ND: Not Detected

4 HUMAN HEALTH EVALUATION

This chapter presents the streamlined human health risk assessment for West Lake Landfill OU-2. Section 4.1 provides an exposure assessment that includes a conceptual model, identification of key exposure media, exposure pathways and receptors and a comparison of site contaminant levels to potential chemical-specific ARARs as recommended in the streamlined approach. The toxicity assessment presents a brief discussion of toxicity information for contaminants that have been detected and exceed the potential chemical-specific ARARs. A risk characterization is also presented that addresses the significant results of the streamlined risk assessment.

4.1 Exposure Assessment

The exposure assessment for the BRA for Operable Unit 2 (OU-2) has been developed consistent with the presumptive remedy approach for evaluating municipal landfills. This includes development of a conceptual model to better understand the site dynamics as to sources of contaminants of potential concern (COPCs) contaminant release and transport and potential human and environmental receptors.

As recommended by USEPA guidance, the evaluation of exposures is also streamlined by comparing RI-derived contaminant concentrations to potential chemical specific ARARs instead of presenting a quantitative assessment of exposure.

Consistent with the current and reasonably expected future uses of the property, industrial, commercial and recreational used were considered in the BRA. The evaluation of the potential risk is also based on exposure scenarios that were limited in part by existing restrictions on current and potential future land uses (institutional controls) at the Site. The evaluation of potential current and future risk is based on the assumption that the existing land use restrictions remain in place as these restrictions cannot be revoked or modified without the consent of EPA and MDNR. Consequently the risk assessment evaluates a “No Further Action” scenario rather than a “No Action” scenario. Unrestricted use of the Site, including possible future residential use was not evaluated as part of the BRA due to the likely industrial and landfill uses of the Site, the presence of deed restrictions limiting future use, and requirements associated with post-closure regulations for solid waste landfills. Consequently the BRA does not evaluate all possible exposure scenarios but rather includes reasonably anticipated future uses.

4.1.1 Conceptual Model for Operable Unit 2

A conceptual model for OU-2 has been developed as part of the baseline risk assessment. The conceptual model has been based on the conceptual model presented in the OU-1 BRA (Auxier, 1998) and the generic conceptual model presented by USEPA for municipal landfill sites (USEPA, 1991a). The purpose of the conceptual site model is to describe the site and its environs and to present potential sources and types of contaminants, transport and release mechanisms, potentially affected media, possible exposure mechanisms and potential human and environmental receptors. The conceptual model illustrated in Figure 6 facilitates evaluation of the risks to human health by providing a basis for identifying and evaluating potential risks to human health from the contaminants detected in OU-2 media. As discussed above, it is based on the following assumptions:

- The property is currently partially covered with vegetation. This vegetative cover can become sparser or denser as time progresses and is dependent on future land uses.

- The infiltration rate of water through the West Lake Landfill soil does not change.

- Surface water runoff is currently collected and channeled by the existing ponds and ditches.

- The future source term is unaffected by chemical degradation.

- The reasonably expected future use of the Site is unsuitable for residential use.

- Deed restrictions on the West Lake Landfill prohibit groundwater wells for drinking water use and residential use of the West Lake Landfill in the future.

A source of COPCs, a release mechanism, an exposure route and a receptor are all necessary components of a complete exposure pathway. If any one of these elements is missing, the exposure pathway is incomplete and no exposure can occur.

The text that follows provides the rational for focusing the streamlined analysis on the specific receptors, exposure routes and contaminant sources that provide the greatest potential contributions to human health risk.

4.1.2 Sources of Contamination

Municipal, industrial and commercial wastes from the OU-2 landfill area are considered potential sources of contamination for the risk assessment. Contaminants from these sources can contribute to exposures for current and potential future receptors. Sources and pathways to key receptors are presented in the OU-2 conceptual model (See Figure 6).

4.1.3 Potential Release/Transport Mechanisms and Media

Chemicals may be released into the environment by a number of processes. These processes are referred to as "release/transport mechanisms" in the conceptual model and this report.

Release/transport mechanisms at the West Lake Landfill have been identified by recognizing the potential interactions of the physical environment with the sources in the OU-2 landfill. The release mechanisms evaluated for OU-2 sources are discussed in the following paragraphs.

1) Direct Contact

Chemicals in surface soil particles can come into direct contact with an individual either through direct dermal contact or ingestion.

2) Volatilization/Wind Dispersion

Volatile chemicals can escape directly from a solid matrix as a vapor in a process called volatilization. Chemicals released in this manner mix with adjacent air and can move freely with the wind. Surface soil particles containing contaminants can also be picked up by winds passing over areas of exposed soil and become suspended for a time in air. This release mechanism has been included in this assessment because the vegetative cover at the West Lake Landfill may decrease in the future, resulting in an increased potential for releases.

3) Soil Erosion and Runoff

Chemicals in surface soil particles can be picked up and carried by flowing surface water during runoff events.

4) Leaching/Infiltration/Percolation

Soluble chemicals within a soil matrix can be dissolved by water percolating through the soil. These dissolved chemicals can then pass through the soil and enter the groundwater beneath the West Lake Landfill. The degree to which a chemical dissolves in water or remains sorbed to the soil matrix is described by the distribution coefficient, K_d, for the element or chemical. A distribution coefficient describes the partitioning of a chemical to soil and to water as the concentration in soil is divided by the concentration in water. The higher the numerical value of the distribution coefficient of a chemical in a soil matrix, the less soluble it is.

5) Radon Emission

Radon is an inert gas that is generated by the decay of radium. Because it is a gas, radon produced in a soil matrix can potentially escape from the soil into the air above it. This is a common process that occurs in all soils, because all soils contain some radium. This release mechanism only becomes significant when radium concentrations in soil reach a critical level. This critical level depends on many factors including the type of soil, the grain size and the presence of overlying soil. Radon emission has been included as a release mechanism in this risk assessment because of radiologically-contaminated soils in the adjacent OU-1. Radon can migrate through the soil and waste matrices and could theoretically move to OU-2. However, this transport mechanism is not significant for exposures at OU-2.

6) Landfill Gas

Several gases are typically generated by decomposition of organic materials in a landfill. The principal gases are carbon dioxide, methane, nitrogen and hydrogen sulfide. Other toxic volatile compounds may also be present. Migration of landfill gas can pose an on-site and off-site fire and explosion hazard. Landfill gas can volatilize and mix with adjacent air. Health and safety air monitoring results were consistently within acceptable background ranges during the site characterization. This indicates that landfill gases are not significantly impacting air quality (Water Management Consultants, 1997). Landfill gas can also become soluble in groundwater.

4.1.4 Exposure Mechanisms

A receptor can come into contact with contaminants in media in a variety of ways, generally as a result of a receptor's work activities, behavior or lifestyle that brings him/her into contact with a contaminated exposure medium. This assessment describes the exposure routes that bring a receptor into contact with a potentially contaminated medium.

An exposure route describes how a chemical may enter or affect the human body. Internal exposures occur when contaminants are introduced directly into the human body through inhalation, ingestion and absorption across dermal surfaces.

The remainder of this section describes the exposure routes evaluated in this assessment. The potential receptors evaluated for these exposure routes are described in Section 4.1.5 below.

1) Exposures from Air

This route assumes a receptor inhales air that contains suspended particulates and gas originating in soil or waste.

2) Exposures from Direct Contact with Soil or Surface Water

Receptors may come into direct contact with contaminated soil or surface water. During the period of contact, the receptors may be exposed through dermal contact with these contaminated media or via inadvertent ingestion of a small amount of soil or surface water.

3) Exposures from Proximal Exposure

Receptors who work near radiologically contaminated areas may be exposed via external exposure. That is, high-energy particles from radionuclides can have harmful effects without being taken into or brought in direct contact with the body. OU-2 does not include radiologically contaminated soils. Therefore, this potential route of exposure is not considered to be part of a complete pathway.

4) Exposures from Ingestion

Receptors may ingest contaminated groundwater through the use of residential and/or commercial wells or, as indicated above, through inadvertent ingestion of a small amount of contaminated soil or surface water.

4.1.5 Potential Human Receptors

Information about the current operation practices at the West Lake Landfill and both current and expected future land-use in and around the West Lake Landfill was used to identify potential receptors that could be impacted by contaminants found in OU-2 media. Although the process for the streamlined BRA does not quantitatively evaluate all potential receptors, it is important to identify receptors and scenarios that combine reasonable land-use assumptions with the greatest potential for exposure at the West Lake Landfill. The OU-1 BRA (Auxier, 1998) provides extensive discussion on several generic receptor scenarios that were considered to be compatible with current and expected future land use of the West Lake Landfill property and surrounding area. The reader is referred to the OU-1 BRA for the discussion of generic receptor scenarios that is not presented here in the streamlined risk assessment for OU-2.

Potential receptors for OU-2 were determined from the OU-1 BRA and by considering compatibility with current and expected future land use and access controls on the West Lake Landfill and adjacent properties. The receptor scenarios judged to be compatible with current and future uses of the West Lake Landfill were then evaluated to determine if a plausible means of exposure existed. That is, could contaminants detected in OU-2 media reach receptors?

Likely human receptors are presented in the conceptual model (Figure 6) and include the following:

Current Scenarios for Receptors within OU-2 Boundaries

Current plausible receptor scenarios for the OU-2 area of the West Lake Landfill are limited to on-site workers such as groundskeepers and transients/trespassers. There are no current ground water wells used for drinking water purposes.

The on-site worker scenario and the trespasser scenario for the West Lake Landfill have complete exposure pathways for contact with surface soil, surface water/sediment, leachate, soil gas and air. The only exposure route possible for a building user on the West Lake Landfill is inhalation of resuspended dust or radon. This route has been eliminated from further consideration as a current exposure scenario based on negative results of air monitoring data and indoor radon measurement data collected by the landfill operator (McLaren/Hart, 1996, Golder, 1996; as cited by Appendix A BRA West Lake Landfill OU-1, Auxier,1998). Therefore, an on-site building user does not have any complete exposure pathways.

Current Receptor Scenarios on Property Surrounding the West Lake Landfill

Potential receptor scenarios were compared to existing land use practices and access controls on property near the landfill. The landfill is surrounded by industrial/commercial property. Casual access to the area is possible but is currently restricted with fences, signs and periodic visual inspection. No permanent residences are located within approximately one-fourth mile of OU-2. Plausible receptor scenarios for these locations include trespassers and industrial/commercial workers. There is also the potential that affected groundwater could be used by residential or commercial receptors located off-site of the landfill.

Receptors at commercial/industrial sites surrounding the West Lake Landfill could potentially be exposed from inhalation of landfill gas released to ambient air or through use of groundwater impacted by OU-2.

Future Receptor Scenarios

Current land-use practices in the properties around the West Lake Landfill and restrictive covenants on the West Lake Landfill were used to forecast the future land-use practices on these properties. For the reasons stated in section 2.7.7.2, above, the reasonably expected future land use is limited to commercial/industrial and does not include residential. Residential land use and groundwater wells for drinking water use are prohibited on the West Lake Landfill by restrictive covenants. The reasonably expected future land use and restrictive covenants limit the number of future plausible receptor scenarios on OU-2 to trespassers or on-site workers such as a groundskeeper. As under current conditions, there is potential for groundwater with contaminants from OU-2 to move off-site where it could be used by residential or commercial receptors located off-site of the landfill.

The future on-site worker scenario and the future trespasser scenario for the West Lake Landfill have complete exposure pathways for contact with surface soil, surface water/sediment, leachate, soil gas and air. As under current conditions, there is potential for groundwater with contaminants from OU-2 to move off-site where it could be used by future residential or commercial receptors located off-site of the landfill. Thus, there is a potential for exposure through the ingestion, inhalation and dermal pathways for contaminants in groundwater.

4.1.6 Identification of Contaminants of Concern

The streamlined approach to evaluating risks at CERCLA municipal landfill sites differs from the typical baseline risk assessment in that quantitative calculations of intakes and risks are not conducted. Instead, pathways that are an obvious threat to human health and the environment are identified by comparing site-specific contaminant concentrations to standards or risk-based chemical concentrations (USEPA, 1991a). Standards and risk-based chemical concentrations have both been used in this streamlined BRA for OU-2 as discussed below.

As indicated by USEPA (USEPA, 1991a), standards that are potential chemical-specific ARARs are maximum contaminant levels for drinking water supply systems (MCLs) and non-zero maximum contaminant level goals (MCLGs) as presented in 40 CFR 141. National Primary Drinking Water Regulations (NPDWRs or primary standards) are legally enforceable standards that apply to public water systems. Primary standards protect drinking water quality by limiting the levels of specific contaminants that can adversely affect public health and are known or anticipated to occur in public water systems. The MCL, as the Safe Drinking Water Act defines, is the level protective of human health that may be achieved with the use of the best available technology, treatment techniques and cost taken into consideration. Secondary MCLs are also available that provide reasonable goals for drinking water quality. They generally address parameters that affect taste, odor or the aesthetic quality of drinking water or impacts to the drinking water system such as corrosivity.

Risk-based chemical concentrations are chemical-specific and media-specific concentrations that are developed using standard default exposure assumptions, USEPA toxicity data and target cancer risks or target hazard quotients. Essentially, risk-based concentrations are risk assessments in reverse, where a concentration is calculated based on a target risk value, as opposed to calculating a risk value given a known constituent concentration. The risk-based concentrations used in the streamlined BRA for OU-2 are the USEPA Region 9 Preliminary Remediation Goals (PRGs). PRGs are risk-based tools for evaluating and cleaning up contaminated sites. They are being used to streamline and standardize all stages of the risk evaluation process at contaminated sites.

The Region 9 PRGs combine current EPA toxicity values with "standard" exposure factors to estimate contaminant concentrations in environmental media (soil, air and water) that are considered protective of humans, including sensitive groups, over a lifetime. Chemical concentrations above these levels would not automatically designate a site as "dirty" or trigger a response action. However, exceeding a PRG suggests that further evaluation of the potential risks that may be posed by site contaminants may be appropriate.

PRGs are chemical concentrations that correspond to fixed levels of risk (i.e. either a one-in-one million [10^{-6}] cancer risk or a noncarcinogenic hazard quotient of 1 in soil, air and water. In most cases, where a substance causes both cancer and noncancer (systemic) effects, the 10^{-6} cancer risk will result in a more stringent criteria.

The following sections provide the comparison of site contaminant concentrations to MCLs, MCLGs, or PRGs on a medium-specific basis. Only groundwater has both potential chemical-specific standards (i.e., MCLs or MCLGs) and PRGs. Only PRGs are available to evaluate the other media. Maximum concentrations of detected contaminants in a medium are compared to the MCL, non-zero MCLG, or PRG. This is a conservative evaluation to identify potential impacts to human health because the maximum concentration is not present at all sample locations. For the OU-2 BRA, [and consistent with the streamlined approach recommended by USEPA (USEPA, 1991a)], if the site-specific contaminant concentration exceeds a standard (i.e., MCL or non-zero MCLG), it is considered a Contaminant of Concern for the risk assessment. If no standard exists, then the site-specific contaminant concentration is compared to a PRG based on maximum beneficial use, that is residential use, of the medium. Contaminants that exceed a PRG but do not exceed an existing standard are not considered Contaminants of Concern.

4.1.6.1 Identification of Groundwater Contaminants of Concern

Table 4.1 details all Contaminants of Concern (COCs) for each hydrogeologic unit sampled as part of the West Lake Landfill Site Characterization. Iron, manganese and total dissolved solids exceeded MCLs or non-zero MCLGs in all hydrogeologic units.

The alluvial hydrogeologic unit contained a larger number of COCs when compared to the other hydrogeologic units, which is expected given its closer proximity to the inactive landfill contents. Detected parameters that exceeded MCLs or non-zero MCLGs for the alluvial hydrogeologic unit included arsenic, iron, manganese, chloride, total dissolved solids, total petroleum hydrocarbons, benzene, bis (2-ethylhexyl)phthalate and vinyl chloride. Bis (2-ethylhexyl)phthalate was only detected one time in all of the sampling events (frequency of detection 1/19 – See Table 3.7). Therefore, although it exceeds an MCL, its presence has not been confirmed. The St. Louis/Upper Salem hydrogeologic unit parameters that exceeded MCLs or non-zero MCLGs included iron, manganese, fluoride, total dissolved solids and benzene. Benzene was only detected in 3 out of 24 St. Louis/Upper Salem groundwater samples (Table 3.4), and was not detected in any one piezometer in both sampling rounds. Therefore, its presence has not been confirmed. Finally, detected parameters that exceeded MCLs or non-zero MCLGs for the Deep Salem hydrogeologic unit included iron, manganese and total dissolved solids. Benzene was detected once (frequency of detection 1/11) in this aquifer at a concentration exceeding the MCL. Therefore, its presence is not confirmed.

The majority of the inorganic and conventional parameters that exceeded MCLs or non-zero MCLGs in the sampled hydrogeologic units can be explained by variations in background. However, organic COCs in the alluvial hydrogeologic unit exceed MCLs and MCLGs by such a factor as to warrant consideration of remedial action under the presumptive remedy approach. In addition, the majority of the parameters that exceeded MCLs and/or MCLGs were located within the inactive landfill in the immediate vicinity of MW-F2.

4.1.6.2 Identification of Soil Contaminants of Concern

Soil data collected as part of the West Lake Landfill Site Characterization did not have any parameters that exceeded recommended PRGs. Therefore, there were no contaminants of concern identified for this medium.

4.1.6.3 Identification of Leachate Contaminants of Concern

Leachate sampling of the West Lake Landfill as part of the Site Characterization identified a number of detected parameters as presented in Table 3.10. There are no standards for leachate constituents. Leachate will not be used as a drinking water source so comparison to PRGs based on drinking water is not appropriate. However, a comparison of parameters detected in leachate to COCs in groundwater is useful to identify leachate parameters that could potentially impact drinking water. Table 4.2 provides a comparison of detected leachate parameters to groundwater COCs. Two parameters, arsenic and benzene, found in leachate are also present as COCs in groundwater.

It is interesting to note that the leachate from the inactive landfill has fewer detected parameters and at lower concentrations that the active landfill. This is probably due to its greater age. Also, the USEPA concern that liquid hazardous waste disposal occurred in the inactive landfill is not supported by the results of the leachate sampling.

4.1.6.4 Identification of Soil Gas Contaminants of Concern

Several contaminants were detected during landfill gas monitoring for the OU-2 Site Characterization as shown in Table 3-9. The West Lake Landfill gas constituents and concentrations are typical of municipal solid waste landfill gas as discussed in Section 8 of the Site Characterization Report (Water Management Consultants, 1997).

Table 4.3 compares typical concentrations of landfill gas constituents to the detected levels of inactive landfill gas constituents in OU-2. For compounds present in both the inactive landfill gas and typical landfill gas, the concentrations of inactive landfill compounds are less than the mean result for typical landfill gas compounds, with the exception of acetone. The acetone concentration for the inactive landfill gas, although slightly greater than the mean concentration in typical landfill gas, is still an order of magnitude less than the maximum concentration for typical landfill gas.

Photoionization detectors as well as combustible gas detectors were used for health and safety air monitoring during site characterization to verify that methane, hydrogen sulfide and organic compound concentrations remained at or near background levels in ambient air. These results were consistently within acceptable background ranges throughout the OU-2 RI, indicating that appreciable landfill gas impacts were not occurring to the ambient air. Detection sampling conducted within the inactive landfill indicated sporadic, isolated landfill gas impacts that are typical for a solid waste landfill.

There were other compounds detected in the landfill gas that were not reported in typical landfill gas. However, these compounds were present at low concentrations and do not suggest a definable source of hazardous substances that is emitting significant vapors into the inactive landfill gas.

PRGs are not used to evaluate landfill gas for this streamlined BRA. PRGs are based on ambient air exposures and represent levels that correspond to a risk of daily lifetime exposure. It is not likely that any individual will be exposed to these parameters identified in the landfill gas under conditions on which the PRGs are based. Exposures will likely only occur for short periods of time during routine maintenance and/or landfill gas monitoring activities. Given these factors, landfill gas is not an exposure concern at the detected levels.

4.1.7 Uncertainty Associated with the Exposure Assessment

With the streamlined approach to risk assessment there are a number of uncertainties and assumptions in the exposure assessment. Examples of such include the assumptions that the groundwater will leave the landfill and remain at the same concentrations and that the detected parameters will reach receptors at the concentrations identified in the Site Characterization. In addition, the maximum concentrations rather than the average concentrations are used in determining whether or not parameters exceed standards and the standards assume lifetime exposure to the COCs, which are not likely to occur in this scenario.

Another assumption in this approach is that the land use will remain the same in the future. For the West Lake Landfill OU-2 area it is highly likely that land use will remain the same for this area, given the current and past use of the Site, the expanding commercial and industrial uses of the property surrounding the Site, the unsuitability of the Site for residential use, and the covenant restrictions.

4.2 Toxicity Assessment

The general procedures for conducting a toxicity assessment are presented in Section 7 of RAGS, Part A (USEPA, 1989). The toxicity assessment for the baseline risk assessment identifies chemical-specific toxicity factors and briefly discusses the key toxicities associated with chemicals evaluated in the BRA.

The streamlined approach to the OU-2 BRA utilizes the toxicity information in a manner different from the typical quantitative risk assessment. Chemical-specific toxicity factors are not used to calculate contaminant-specific risks. Instead, they are used as part of the calculation of the PRG (as discussed in Section 4.1.6) in order to derive risk-based contaminant concentrations that can be compared to site contaminant concentrations.

The following sections briefly discuss the toxicity factors used in the streamlined BRA for OU-2.

4.2.1 Toxicity Assessment for Noncarcinogenic Effects

Systemic, toxic effects (other than cancer) may be associated with exposures to chemicals. The toxicity value used to evaluate potential noncancer (i.e., noncarcinogenic) effects is the reference dose (RfD). The RfD has been developed by the USEPA based on the assumption that thresholds exist for certain toxic effects. In other words, a certain amount (i.e., dose) of the chemical is required to be ingested, inhaled or absorbed through the skin to produce an undesirable noncancer health effect. In general, the RfD is an estimate of a daily exposure level for the human population, including sensitive populations, that is likely to be without a significant risk of noncancerous effects during a lifetime. The RfD is developed to reflect the duration of exposure, the route of exposure (such as inhalation or ingestion) and is one of the parameters used to develop PRGs.

The RfDs for all contaminants of concern at OU-2 and their associated uncertainty factors, primary target organs and modifying factors, as published by USEPA in the Integrated Risk Information System (IRIS), the Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997b), or Region IX PRG Toxicity Tables (USEPA, 1999b), are presented in Table 4.4.

4.2.2 Toxicity Assessment for Carcinogenic Effects

Toxicity values have also been developed for evaluating potential human carcinogenic effects from exposure to carcinogens. Potential human carcinogenic effects are evaluated using the chemical-specific slope factor (SF) and accompanying USEPA weight-of-evidence determination. The SF values have been derived by the USEPA based on the concept that for any exposure to a carcinogenic chemical there is always a carcinogenic response (i.e., no threshold level exists). The SF is used in risk assessment to estimate an upper-bound lifetime probability of an individual developing cancer as a result of a specific exposure to a carcinogen and is also one of the parameters used in the development of the PRG. In addition to the SF, as published in IRIS, HEAST, or Region IX PRG Toxicity Tables (USEPA, 1999b), the likelihood that a substance is a human carcinogen is also considered. Toxicity information for carcinogenic COCs is presented in Table 4.5.

4.2.3 Uncertainty Associated with the Toxicity Assessment

An understanding of the degree of uncertainty associated with toxicity values is an important part of interpreting and using those values. A high degree of uncertainty in the information used to derive a toxicity value contributes to less confidence in the assessment of risk associated with exposure to a substance.

The RfDs and SFs, used to develop PRGs, have multiple conservative calculations built into them that can contribute to overestimation of actual risk. For example, factors of up to 10 for four different levels of uncertainty may be incorporated into an RfD and a 95% upperbound confidence estimate derived from the linearized multi-stage carcinogenic model is usually incorporated in the SFs.

In addition, uncertainty arises from the extrapolation of data from high-dose animal studies to low-dose environmental human exposures and may overestimate the risk to human receptors because of the differences in metabolic rates, molecular repair mechanisms or differences in susceptibility.

4.3 Risk Characterization

This section presents the results of the streamlined baseline risk assessment for COCs in all relevant exposure media. The risk characterization typically combines information from the exposure assessment and the toxicity assessment to characterize potential noncancer and cancer risks that may be associated with the ingestion, dermal contact and/or inhalation of site contaminants. Contaminant concentrations were determined from the Site Characterization conducted by Water Management Consultants (1997). The risk characterization presents only a qualitative description of potential risk in accordance with the streamlined approach for municipal landfills recommended by USEPA. In essence, if a detected parameter exceeds a given standard (MCL or non-zero MCLG) in the environmental media tested, an unacceptable risk exists and remedial action is warranted.

Using the streamlined approach, a qualitative estimate of risk is performed. In order to determine that an excess risk is evident, it needs to be demonstrated that there are contaminants that exceed MCLs or non-zero MCLGs. Carcinogenic contaminants exceeding MCLs or non-zero MCLGs that have been identified in the West Lake Landfill include, for groundwater: arsenic, benzene, and vinyl chloride.

Non-carcinogenic contaminants that exceed MCLs or non-zero MCLGs in the West Lake Landfill include for groundwater, iron, manganese, chloride, total dissolved solids and fluoride. Most of these conventional parameters may reflect background groundwater conditions. Total petroleum hydrocarbons also exceeded the Missouri Department of Natural Resources Tier 1 Cleanup Levels.

Safe Drinking Water Act and State requirements will not allow human consumption of water containing contaminants above their respective MCLs. Based on the presumptive remedy approach for municipal landfills, contaminants were identified in groundwater at concentrations that exceeded their MCLs or non-zero MCLGs. Based on these findings, consideration of remedial action under the presumptive remedy approach is warranted.

4.4 Uncertainties Associated with the Risk Characterization and Human Health Evaluation

The results of this risk characterization should be understood in light of the uncertainties outlined in the data evaluation, exposure assessment and toxicity assessment. The uncertainties in the information in each of these steps of the risk assessment contribute to uncertainty in the risk characterization.

Figure 6. Site Conceptual Model For West Lake Landfill Operable Unit 2

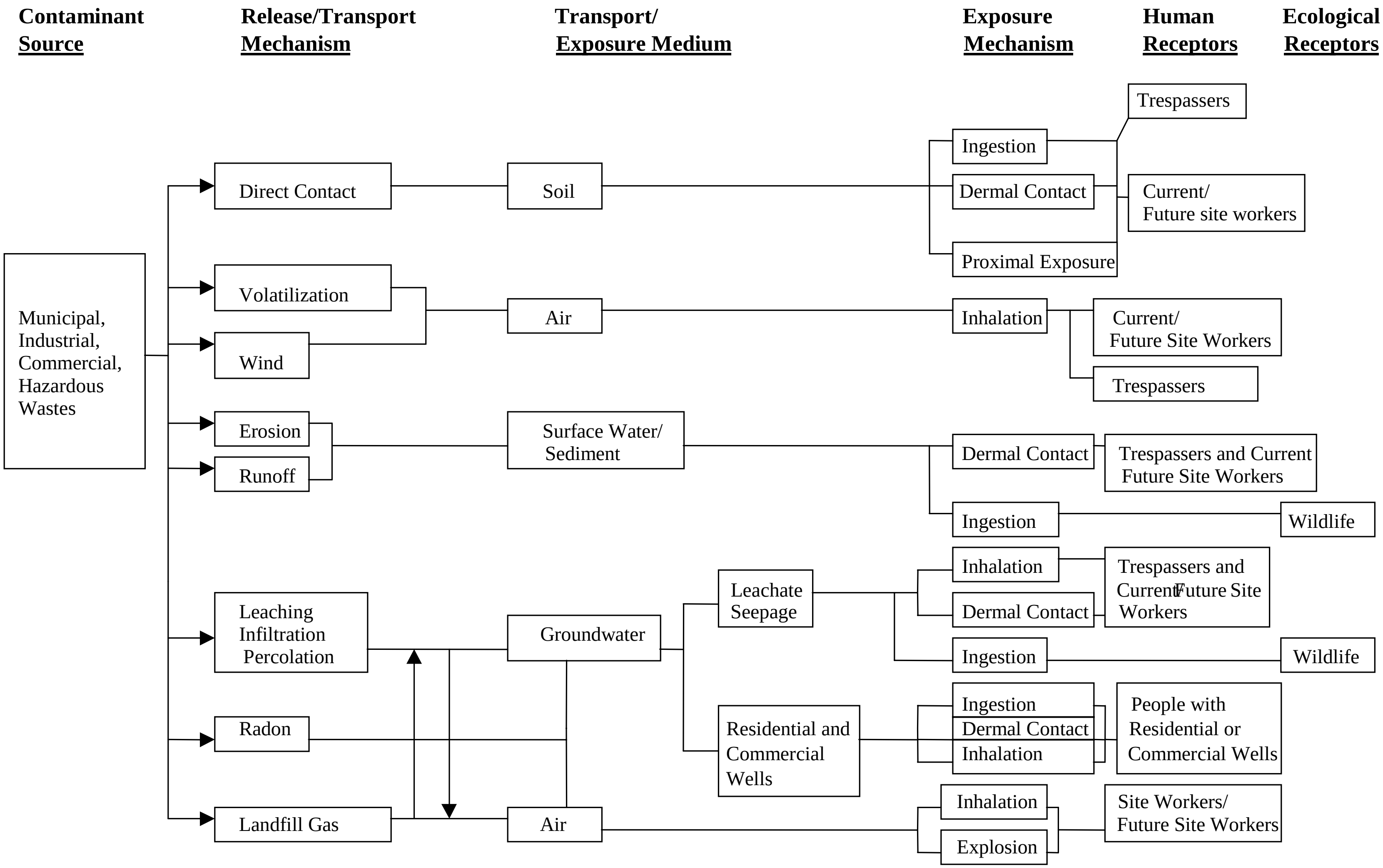

Table 4.1 Summary of Detected Parameters Which Exceed MCLs or MCLGs in Groundwater

Parameter	Range of Detection Results	Piezometer Exhibiting the Maximum Detection Concentration	PRG	Exceed (Y/N)	MCL	Exceed (Y/N)	COPC (Y/N)
Groundwater							
Alluvium							
Metals	**(mg/L)**		**(mg/L)**				
Arsenic (Dissolved)	<0.002 to 0.094	PZ-304-AS	0.000045	Y	0.05 [a]	Y	Y
Arsenic (Total)	<0.002 to 0.087	PZ-303-AS	0.000045	Y	0.05 [a]	Y	Y
Iron (Dissolved)	<0.04 to 92	PZ-303-AS	11	Y	0.3 [b]	Y	Y
Iron (Total)	0.063 to 90.1	PZ-303-AS	11	Y	0.3 [b]	Y	Y
Manganese (Dissolved)	0.017 to 6.54	PZ-113-AS	0.88	Y	0.05 [b]	Y	Y
Manganese (Total)	0.077 to 6.39	PZ-113-AS	0.88	Y	0.05 [b]	Y	Y
Conventionals	**(mg/L)**		**(mg/L)**				
Chloride	17 to 299	PZ-304-AS	N/A	N/A	250 [b]	Y	Y
Total Dissolved Solids	86 to 1396	PZ-303-AS	N/A	N/A	500 [b]	Y	Y
Volatiles/Organics	**(mg/L)**		**(mg/L)**				
Benzene	<0.002 to 0.078	PZ-303-AS	0.00041	Y	0.005 [a]	Y	Y
Vinyl chloride	<0.001 to 0.026	PZ-303-AS	0.00002	Y	0.002 [a]	Y	Y
Total Petroleum Hydrocarbons	13.12 to 21.3	PZ-303-AS	N/A	N/A	10 [d]	Y	Y
St. Louis/Upper Salem							
Metals	**(mg/L)**		**(mg/L)**				
Iron (Dissolved)	<0.04 to 4.24	PZ-110-SS	11	N	0.3 [b]	Y	Y
Iron (Total)	<0.04 to 5.87	PZ-110-SS	11	N	0.3 [b]	Y	Y
Manganese (Dissolved)	<0.01 to 0.375	PZ-201A-SS	0.88	N	0.05 [b]	Y	Y
Manganese (Total)	0.017 to 0.528	PZ-201A-SS	0.88	N	0.05 [b]	Y	Y

Conventionals	**(mg/L)**		**(mg/L)**				
Fluoride	0.49 to 2.7	PZ-113-SS	2.2	Y	2 [b]	Y	Y
Total Dissolved Solids	364 to 1418	PZ-110-SS	N/A	N/A	500 [c]	Y	Y
Deep Salem							
Metals	**(mg/L)**		**(mg/L)**				
Iron (Dissolved)	<0.04 to 0.945	MW-1204	11	N	0.3 [b]	Y	Y
Iron (Total)	0.119 to 2.09	PZ-100-SD	11	N	0.3 [b]	Y	Y
Manganese (Dissolved)	0.016 to 0.238	PZ-106-SD	0.88	N	0.05 [b]	Y	Y
Manganese (Total)	0.017 to 0.332	PZ-100-SD	0.88	N	0.05 [b]	Y	Y
Conventionals	**(mg/L)**		**(mg/L)**				
Total Dissolved Solids	340 to 665	PZ-106-SD	N/A	N/A	500 [b]	Y	Y

[a] Primary MCL 40CFR 141.11
and 141.62
[b] Secondary MCL 40CFR 143.3
[c] MCLG 40 CFR 141.51
[d] Missouri Department of Natural Resources Division of Environmental Quality, Sept. 1998, Appendix B Tier 1 Clean-up Levels
[e]One detect only
PRGs cited from Region IX Preliminary Remediation Goals (PRGs), United States
Environmental Protection Agency. October 1, 1999.

Table 4.2 Comparison Between Compounds Detected in Leachate and Compounds of Concern (COCs) in Groundwater

Compound	Range of Detection Results (mg/L)	Piezometer Exhibiting the Maximum Detection Concentration	COC in Groundwater (Y/N)
<u>Metals</u>			
Arsenic (Total)	**0.009 to 0.176**	**LC-LR-103**	**Y**
<u>Volatiles/Organics</u>			
Acetone	<0.010 to 1.2	LC-LCS-1	N
Benzene	**<0.005 to 0.009**	**LC-LCS-2**	**Y**
Chlorobenzene	<0.005 to 0.74	LC-LR-105	N
1,4-Dichlorobenzene	<0.005 to 0.081	LC-LCS-2	N
Ethylbenzene	<0.005 to 0.089	LC-LR-105	N
2-Hexanone	<0.010 to 0.18	LC-LCS-4	N
Methyl Ethyl Ketone	<0.010 to 3.0	LC-LCS-1	N
Methyl iso-butyl Ketone	<0.010 to 0.08	LC-LCS-2	N
Styrene	<0.005 to 0.006	LC-LCS-4	N
Toluene	<0.005 to 0.15	LC-LCS-3	N
Total Xylenes	<0.005 to 0.43	LC-LR-105	N
M+P Cresol	<0.010 to 1.9	LC-LCS-1	N
2,4-Dimethylphenol	<0.010 to 0.082	LC-LR-105	N
Diethyl phthalate	<0.010 to 0.033	LC-LCS-1	N
Dimethyl phthalate	<0.010 to 0.012	LC-LCS-1	N
Phenol	<0.010 to 0.29	LC-LCS-1	N
Naphthalene	<0.010 to 0.011	LC-LR-100	N
Volatile Petroleum Hydrocarbons	<0.05 to 0.95	LC-LR-105	N
Petroleum Hydrocarbons (Diesel)	0.08 to 79	LC-LCS-1	N

Table 4.3 West Lake Inactive Landfill Gas Concentrations Versus Typical Municipal Solid Waste Landfill Gas Constituents

Typical Landfill Gas Constituents*			Inactive Landfill Gas		
Detected Compound	Mean Result (ppmV)	Maximum Result (ppmV)	Detected Compound	Result (ppmV)	Location
Acetone	6.83	240.0	Acetone	24.0	LG-05
Benzene	2.06	39.0	Benzene	0.41	LG-08
Chlorobenzene	0.08	1.64	Chlorobenzene	1.10	LG-05
Chloroform	0.25	12.0			
1,1-Dichloroethene	2.80	36.0			
Dichloromethane	25.7	620.0			
1,1-Dichloroethane	0.13	4.0			
Diethylene chloride	2.84	20.0			
1,2-trans-Dichloroethane	0.13	0.85			
Ethyl benzene	7.33	87.5	Ethyl benzene	0.24	LG-10
Methyl ethyl ketone	3.09	130.0	Methyl ethyl ketone	0.18	LG-08
1,1,1-Trichloroethane	0.61	14.5			
Trichloroethylene	2.08	32.0			
Toluene	34.9	280.0	Toluene	1.20	LG-10
1,2,2-Tetrachloro-ethane	0.25	16.0			
Tetrachloroethylene	5.24	180.0			
Vinyl Chloride	3.51	32.0	Vinyl Chloride	0.74	LG-08
Styrenes	1.52	87.0			
Vinyl Acetate	5.66	240.0			
Xylenes	2.65	38.0	Xylenes	0.91	LG-10
			Chloroethane	0.25	LG-01
			4-ethyl Toluene	0.05	LG-10
			Freon 11	0.02	LG-10
			Freon 12	0.78	LG-09
			Freon 114	0.52	LG-08
			Methylene chloride	0.06	LG-07
			1,4-Dichlorobenzene	0.07	LG-05
			1,2,4-Trimethyl-benzene	0.26	LG-05
			1,3,5-Trimethyl benzene	0.07	LG-05
			1,2-cis-Dichloro-ethylene	0.01	LG-04
			Carbon disulfide	0.13	LG-01

*Source: Tchobanoglous et al., 1993.

Table 4.4 RfDs for all Contaminants of Concern at OU-2 and their Associated Uncertainty Factors, Primary Target Organs and Modifying Factors

Contaminants of Concern (COCs)	Reference Dose** (RfD)	(units)	Uncertainty Factor (UF)	Critical Effect	Modifying Factor	Confidence Level***
Oral	**RfDo**					
Arsenic	3.00E-04	mg/kg-d	3*	Multiple: Lung, Skin, Liver, Kidney, Bladder*	1*	M*
Benzene	3.00E-03	mg/kg-d	NA	Hematopoetic System#	NA	NA
Chloride	NA		NA	NA	NA	NA
Fluoride	6.00E-02	mg/kg-d	1*	Dental Fluorosis*	1*	H*
Iron	3.00E-01	mg/kg-d	NA	NA	NA	NA
Manganese	1.40E-01	mg/kg-d	1*	Respiratory system, nervous system*	1*	M*
Vinyl Chloride	NA	NA	NA	NA	NA	NA
Total Petroleum Hydrocarbons	NA	NA	NA	NA	NA	NA

*Source: U.S. EPA Integrated Risk Information System, online at http://www.epa.gov/iris/, February 3, 2000.
NA: Not Available
**Source: U.S. EPA Region 9 Preliminary Remediation Goals (PRGs), October 1, 1999.
***Confidence Level: H=High; M=Medium; L=Low
#Source: U.S. EPA Health Effects Assessment Summary Tables (HEAST), 1997.

Table 4.5 Toxicity Information for Carcinogenic COCs

Contaminants of Concern (COCs)	Slope Factor (SF) (units)	Weight of Evidence Classification
Oral		
Arsenic	1.50E+00 1/mg/kg-d*	A; Human Carcinogen*
Benzene	2.90E-02 1/mg/kg-d*	A; Human Carcinogen*
Vinyl Chloride	1.90E+00 1/mg/kg-d***	A; Human Carcinogen**

*Source: U.S. EPA Integrated Risk Information System, online at http://www.epa.gov/iris/, February 3, 2000.
**Source: U.S. EPA Health Effects Assessment Summary Tables (HEAST), 1997.

5 ECOLOGICAL EVALUATION

5.1 Qualitative Evaluation of Ecological Impacts for OU-2

The entire area surrounding the West Lake Landfill is rapidly being developed for commercial/light industrial purposes. The area north of the landfill across St. Charles Road, as well as the area west of the landfill in Earth City, has previously been developed. Subsequent to initiation of the OU-2 RI/FS, the areas south and east of the landfill have also undergone extensive commercial/light industrial development. The heavy development in the area has eliminated almost all previously existing plant and animal habitats and has therefore significantly reduced the number and type of potential ecological receptors.

The biological characteristics near the West Lake Landfill were evaluated as part of the West Lake Landfill Operable Unit 1 (OU-1) RI/FS. As described in the *Site Characterization Summary Report* prepared by Engineering Management Support, Inc and dated August 1997, the U.S. Fish and Wildlife Service reported "no federally-listed endangered or threatened species occur in the project area." The Missouri Department of Conservation reported "Department staff examined map and computer files for federal and state threatened and endangered species and determined that no sensitive species or communities are known to occur in the immediate Site or surrounding area." An unsubstantiated and unverified report of the Western Fox Snake near the site was made. Subsequent examinations of areas most likely to be inhabited by the Western Fox Snake by McLaren/Hart Environmental Engineering Corporation as part of the OU-1 RI/FS activities failed to confirm the presence of the Western Fox Snake.

The OU-1 biological survey identified numerous species and signs of wildlife. Deer tracks were noted and rabbits were observed. Red-winged black birds, robins and crows were also observed. A great blue heron was observed in the Earth City stormwater retention pond. The possible presence of coyotes or red fox was inferred from observation of several pellets containing fur and a potential den. Although local populations of some common species may be present in the area, OU-2 is not a highly sensitive or ecologically unique environment.

As described in the *Work Plan*, the ecological evaluation performed for the OU-1 RI/FS was intended to form the basis for describing biological characteristics for OU-2. If the OU-1 biological evaluation were determined to be insufficient, supplemental activities would be performed as part of the OU-2 RI/FS. No further biological investigations are considered necessary to evaluate the ecological risks for OU-2 given the lack of sensitive ecological receptors (i.e., threatened and endangered species) identified as part of the OU-1 BRA and the extensive human-made impacts at OU-2 and to the area surrounding the West Lake Landfill through commercial/light industrial development activities.

The streamlined risk assessment for OU-2, as discussed in the human health evaluation, has identified groundwater as the primary media of concern. Groundwater is not readily accessible to ecological receptors and the site characterization suggests that groundwater will not adversely impact ecologically sensitive areas. Surface water and sediment sampling results do not indicate off-site release of contaminants from run off and on-site sampling do not suggest that there would be releases through run off in the future.

6 SUMMARY AND CONCLUSIONS

This baseline risk assessment (BRA) was prepared as part of the Remedial Investigation/ Feasibility Study (RI/FS) for West Lake Landfill Operable Unit 2 (OU-2), Bridgeton, Missouri. The BRA provides an assessment of baseline health risks and environmental impacts. It is one of the key elements in the process to evaluate hazardous waste sites as set forth under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

The OU-2 BRA was prepared in accordance with the presumptive remedy approach for municipal landfills. The United States Environmental Protection Agency (USEPA) has recognized that certain categories of sites - for example, municipal landfills - have similar characteristics, such as types of contaminants, types of disposal practices, or how environmental media are affected (USEPA, 1993a). Based on information acquired from evaluating and cleaning up these sites, USEPA has initiated the use of presumptive remedies to accelerate cleanups at these sites. As part of the presumptive remedy approach, the BRA may be streamlined to facilitate action to address obvious threats to human health or the environment.

Field investigative activities for OU-2 were designed to meet the objectives of Section 3.1 of the Statement of Work (SOW). As described in the EPA-approved *Remedial Investigation/ Feasibility Study Work Plan, West Lake Landfill Operable Unit 2, Bridgeton, Missouri (Work Plan), Appendix A-01, Field Sampling Plan* prepared by Golder Associates Inc. (Golder, 1995), the primary objectives of the West Lake Landfill Operable Unit 2 (OU-2) RI were to collect data on and adjacent to OU-2 regarding environmental characteristics, chemical occurrence, potential chemical migration pathways and transport mechanisms. These data were used in the evaluation and qualitative assessment of risk associated with exposures to contaminants present at the OU-2 site and are summarized in Chapters 2 and 3 of the BRA.

The phased approach to site characterization is a site-specific strategy that frames the data collection effort within the context of determining whether a risk is present at a site rather than characterizing the nature and extent of all contamination at a landfill (USEPA, 1991a). The West Lake Landfill OU-2 RI and Site Characterization efforts sampled a variety of environmental media for landfill contaminants. Groundwater was the medium most extensively sampled as part of the West Lake Landfill Site Characterization and presented parameters above detection limits, including, but not exclusive to, organics and metals which were further evaluated in this risk assessment.

The streamlined approach to evaluating risks at CERCLA municipal landfill sites differed from the typical baseline risk assessment in that quantitative calculations of intakes and risks were not conducted. Instead, pathways that were an obvious threat to human health and the environment were identified by comparing site-specific contaminant concentrations to standards or risk-based chemical concentrations (USEPA, 1991a). Standards and risk-based chemical concentrations were both used in this streamlined BRA for OU-2. Standards used included maximum contaminant levels (MCLs) and non-zero maximum contaminant level goals (MCLGs) as presented in 40 CFR 141. Risk-based chemical concentrations were developed using standard default exposure assumptions, USEPA toxicity data and target cancer risks or target hazard quotients. The risk-based concentrations used in the streamlined BRA for OU-2 were the USEPA Region 9 Preliminary Remediation Goals (PRGs).

Groundwater had both potential chemical-specific standards (i.e., MCLs or non-zero MCLGs) and PRGs. Only PRGs were available to evaluate the other media. Maximum concentrations of detected contaminants in a medium were compared to the MCL, non-zero MCLG, or PRG.

This served as a conservative evaluation to identify potential impacts to human health because the maximum concentration was not present at all sample locations. For the OU-2 BRA, [and consistent with the streamlined approach recommended by USEPA (USEPA, 1991a)], if the site-specific contaminant concentration of a confirmed parameter exceeded a standard (i.e., MCL or non-zero MCLG), it was considered a Contaminant of Concern for the risk assessment. If no standard existed, then the site-specific contaminant concentration was compared to a PRG based on maximum beneficial use which is residential use of the medium. Residential use is an unrealistic worst-case scenario for the site. Contaminants that exceeded a PRG but did not exceed an existing standard were not considered Contaminants of Concern.

Groundwater sampling results showed that the alluvial hydrogeologic unit contained a larger number of COCs when compared to the other hydrogeologic units, which was not unexpected given its closer proximity to the inactive landfill contaminants. Detected parameters which exceeded MCLs or non-zero MCLGs for the alluvial hydrogeologic unit (as well as all other hydrogeologic units) are presented in Chapter 4 (Section 4.1.6.1). The majority of the inorganic and conventional parameters that exceeded MCLs or non-zero MCLGs in the sampled hydrogeologic units can be explained by variations in background. However, organic COCs in the alluvial hydrogeologic unit exceeded MCLs and non-zero MCLGs by such a factor as to warrant consideration of remedial action under the presumptive remedy approach. In addition, the majority of the parameters that exceeded MCLs and/or non-zero MCLGs were near the inactive landfill in the immediate vicinity of MW-F2.

Soil data collected as part of the West Lake Landfill Site Characterization did not have any parameters that exceeded recommended PRGs. Therefore, there were no contaminants of concern identified for this medium.

Leachate sampling of the West Lake Landfill as part of the Site Characterization identified a minimal number of contaminants. There are no standards for leachate constituents and comparison to PRGs based on drinking water is not appropriate because leachate is not used as a drinking water source. Parameters detected in leachate were useful for identification of contaminants that could impact groundwater used as a drinking water source. Two contaminants were identified in leachate that are also COCs in groundwater. They are arsenic and benzene. In general, the leachate from the inactive landfill had fewer detected parameters and at lower concentrations than the active landfill. This is probably due to its greater age. The leachate sampling results also do not support the USEPA concern that liquid hazardous waste disposal occurred in the inactive landfill.

Landfill gas monitoring conducted as part of the West Lake Landfill Site Characterization identified sporadic, isolated landfill gas impacts that are typical for a solid waste landfill. There were other compounds detected in the landfill gas that are often not reported in typical landfill gas. However, these compounds were present at low concentrations and do not suggest a definable source of hazardous substances that is emitting significant vapors into the inactive landfill gas. PRGs were not used to evaluate landfill gas for this streamlined BRA. It is unlikely that any individual would be exposed to these parameters identified in the landfill gas under conditions on which the PRGs are based. Furthermore, exposures will likely only occur for short periods of time during routine maintenance and/or landfill gas monitoring activities. Given these factors, the parameters detected in the landfill gas are unlikely to pose an exposure concern at the detected levels

In the streamlined approach being used for this BRA, only a qualitative estimate of risk was needed. In essence, if a detected parameter exceeded a given standard (MCL or non-zero MCLG) in the environmental media tested, an unacceptable risk exists and remedial action is warranted. This approach does not consider the fact that there is no current drinking water use of groundwater near the landfill at this time.

Carcinogenic contaminants exceeding MCLs or non-zero MCLGs which were identified in the alluvial groundwater sampling for the West Lake Landfill included arsenic, benzene and vinyl chloride.

Non-carcinogenic contaminants that exceeded MCLs or non-zero MCLGs in the West Lake Landfill included, for groundwater, iron, manganese, chloride, total dissolved solids and fluoride. However, most of these conventional parameters appear to reflect background groundwater conditions. Total petroleum hydrocarbons also exceeded the Missouri Department of Natural Resources Tier 1 Cleanup Levels.

A qualitative ecological evaluation was conducted for OU-2. Although local populations of some common species may be present in the area, OU-2 is not a highly sensitive or ecologically unique environment. The streamlined risk assessment for OU-2, as discussed in the human health evaluation, identified groundwater as the primary media of concern. Groundwater is not readily accessible to ecological receptors and the site characterization suggests that groundwater will not adversely impact ecologically sensitive areas. Surface water and sediment sampling results do not indicate off-site release of contaminants from run-off and on-site sampling do not suggest that there would be releases through run off in the future

In conclusion, Safe Drinking Water Act and State requirements will not allow human consumption of water containing contaminants above their respective MCLs or MCLGs. There is also no current or anticipated future drinking water use of the groundwater near the landfill. Using the presumptive remedy approach for municipal landfills, both carcinogenic and non-carcinogenic contaminants were identified in groundwater at concentrations that exceeded their MCLs or non-zero MCLGs. Based on these findings, consideration of remedial action under the presumptive remedy approach is warranted.

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